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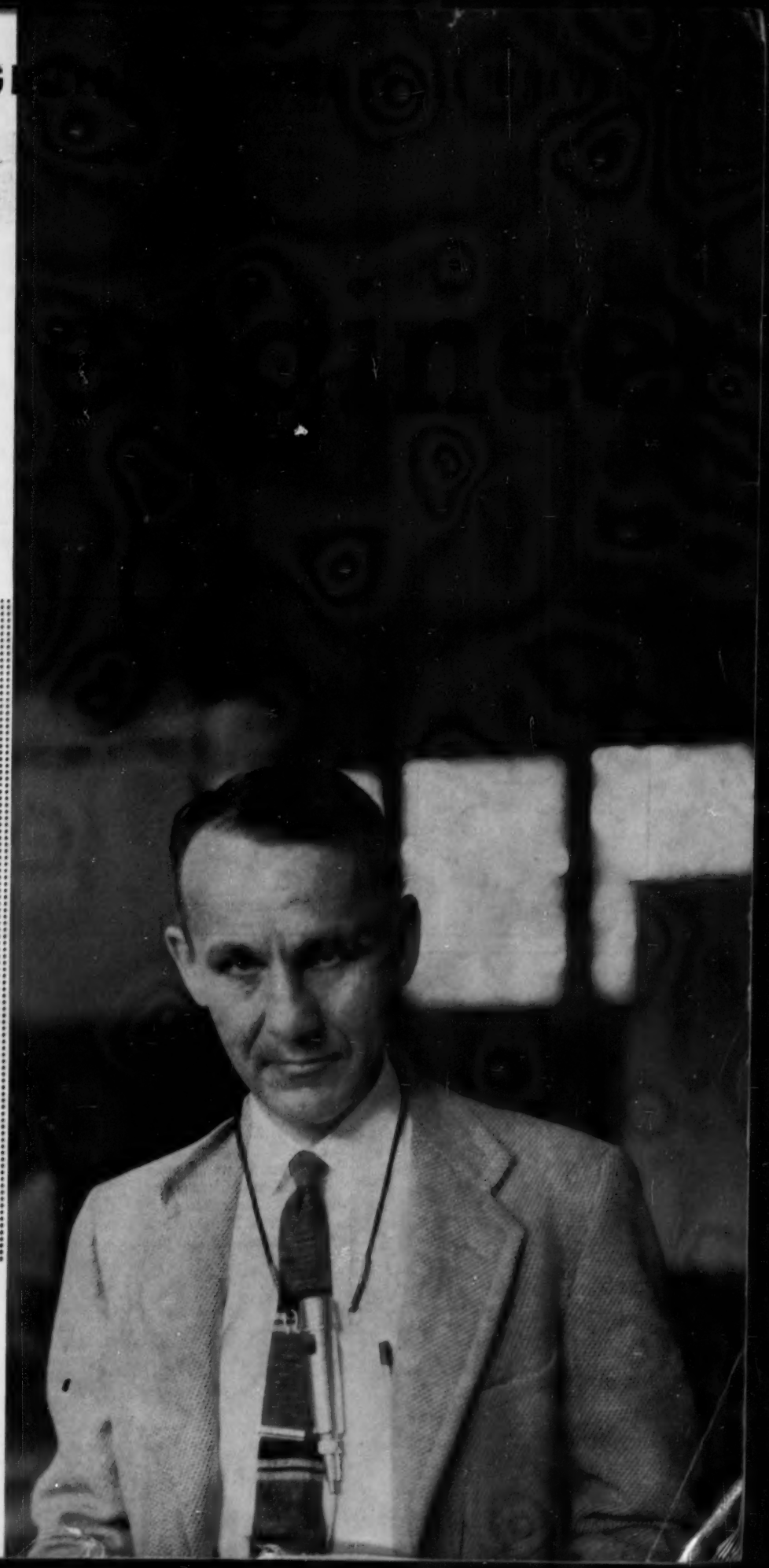
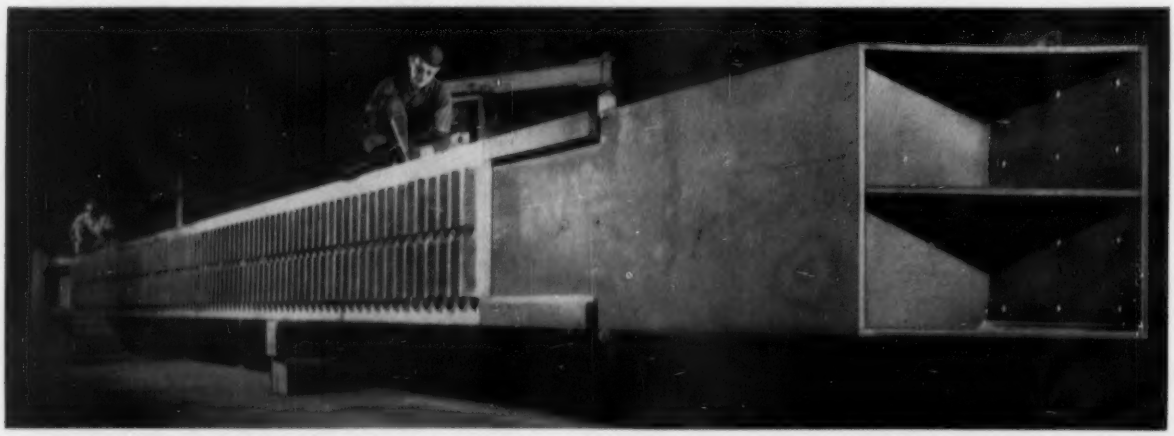


OCTOBER, 1957
VOL. 23, NO. 1
25 CENTS

Only STEEL can do so many jobs so well

Steelaire Home. The entire structural frame of this house is made from tough, cold-formed steel, so it is unaffected by rot, fungus, and termites. Even more important is the fact that the steel frame resists warping and sagging. It's one of a line of *Steelaire* homes and is made by the U. S. Steel Homes Division of United States Steel.



World's Biggest Crowd. On power shovels, a "crowd" is the arm which moves the dipper and dipper-stick forward and back. It coordinates closely with the lift motion of the dipper, and is a key part in the operation of the shovel which must withstand extremes of stress at any temperature. This is a picture of the biggest crowd ever built, now installed on the biggest power shovel in the world. It's made from USS "T-1" Steel, the remarkable new constructional alloy steel developed by United States Steel. An exceptionally strong and tough steel, it is noted for its welding characteristics. *"USS" and "T-1" are registered trademarks.*

Slap That Bermudavarius! The Talbot Brothers of Bermuda, famous for their colorful calypso music, recently retired their homemade packing-case "bass viol," and proudly premiered in its place the world's first Stainless Steel bass viol (or dog house or Bermudavarius, as it's customarily referred to). An exact replica in USS Stainless Steel of their original homemade design, it was built for them under U. S. Steel's supervision by a well-known manufacturer of Stainless Steel sinks who commented that the fabricating job wasn't difficult—but certainly was *different.*

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Watch the **United States Steel Hour** on TV every other Wednesday (10 p.m. Eastern time).

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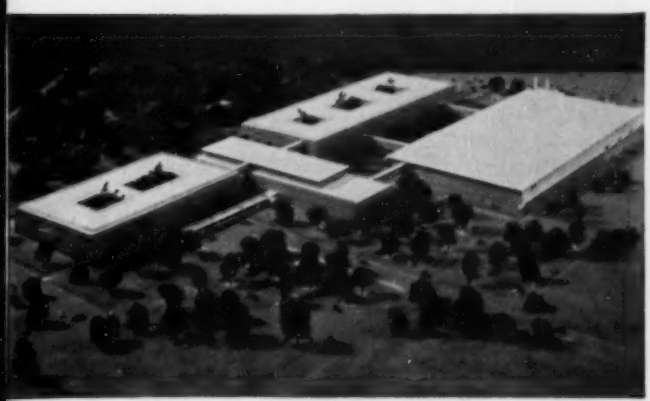
TO NOURISH AN IDEA

Dr. Peter J. W. Debye, professor emeritus of chemistry at Cornell University, and Dr. Lloyd P. Smith, President, Avco Research and Advanced Development Division, discuss the Avco research program prior to Dr. Debye's recent colloquium at the Division's Lawrence, Massachusetts, headquarters.



Pictured above is our new Research Center now under construction in Wilmington, Massachusetts. Scheduled for completion in early 1958, this ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.

Avco's new research division now offers unusual and exciting career opportunities for exceptionally qualified and forward-looking scientists and engineers in such fields as:

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Write to Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Division, 20 South Union Street, Lawrence, Massachusetts.

THE FULL IMPACT of science on man and his economy is just beginning to be realized. Past achievements, translated into today's technology, are transforming the world.

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Some of America's foremost scientists and engineers are at work here. Consultants, like Dr. Peter J. W. Debye, contribute through colloquia and the stimulation of the inter-disciplinary currents imperative to high-level scientific performance.

Avco's scientific approach to urgent national defense problems has already brought advances in high-altitude, high-speed flight, missile re-entry, aerodynamics, heat transfer, materials and other areas. Practical problems have been solved; scientific horizons have been widened. But the greatest challenge at Avco lies with work yet to be done.

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THE CORNELL engineer

OCTOBER 1957 VOLUME 23 NO. 1

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Editorial:

A QUESTION FOR FRESHMAN ENGINEERS

How can I make the most of my next five years at Cornell? In June, 1962, September's freshmen will graduate, ready to contribute to the miraculous age of technology that has far reaching impact on the life of every man on earth. Making the most of the next five years is a crucial problem for all freshmen. How they go about it will mold their careers and thereby influence many of their fellow men.

The opportunity of Cornell is its response to each student's need and initiative. The curricula of the College of Engineering fills the need for a thorough foundation in math and basic science on which is built an inter-related structure of engineering fundamentals, essential liberal courses, and advanced technical electives. With initiative, freshmen can add the breadth of personal experience to the depth of classwork, through participation in campus activities, social life, and cultural events.

For the engineering student, making the most of one's time at Cornell depends on combining academic achievement with extra-curricular growth. To graduate in 1962 with only one part of the combination is to miss the meaning of Cornell education.

Spending time is a basic problem that freshmen engineers must solve to make the most of their next five years. Few students can do everything on campus and pass courses too, especially during their freshman year. Freshmen should meet their academic responsibility first, by concentrating on doing their best to develop good study habits. Engineering freshmen should spend ample time learning to solve problems accurately, by carefully and thoughtfully working out every homework assignment. Rather than taking it for granted that they "know the theory," they should practice applying theory by writing out problem solutions.

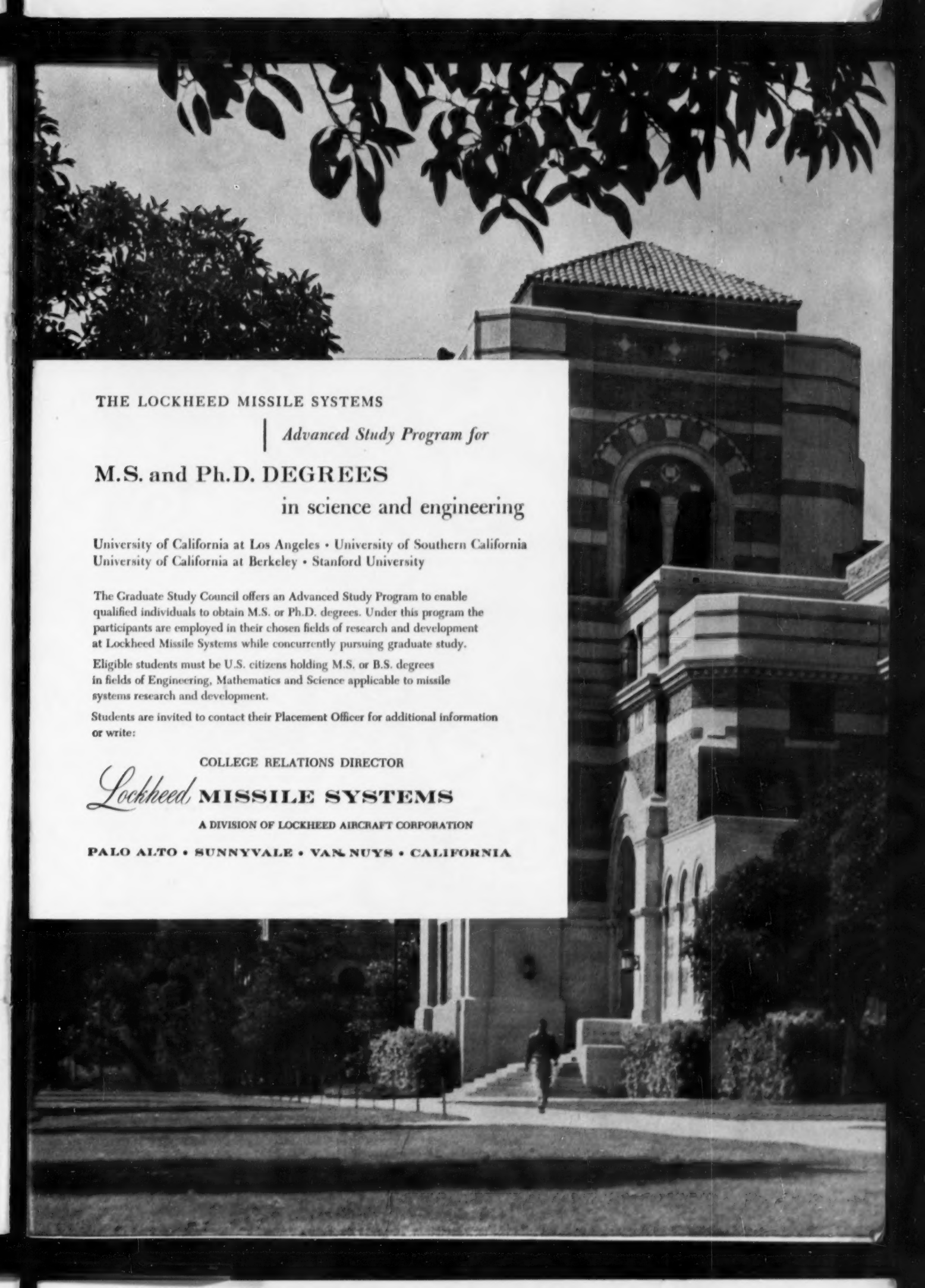
After getting the feel of academic responsibilities, most freshmen have time for one major activity. This activity should be a change and a challenge. It should be an enjoyable variation from the mental discipline of classwork, and challenge the student to give of his energy and talents. Choosing an activity during the freshman year is important because starting from the bottom, the student can work up to greater meaning and responsibility in the activity before graduation.

Asking questions is essential in making the most of the next five years. Freshmen engineers should constantly strive to develop inquiring minds in and out of class. They should not be misled by large freshman lectures, but rather ask professors and instructors every honest question required to obtain adequate understanding of a topic. Teachers encourage freshmen to ask questions after class or during office hours because questions help teachers improve their classroom presentations and enable the faculty to meet individual students.

To guard against becoming intellectually narrow, engineers must ask questions and seek answers about disciplines other than technical fields. Choosing liberal electives, selecting books and articles for leisure reading, and attending the wide variety of University lectures and programs, are effective methods for cultivating a broader perspective. Asking questions about people, learning their goals and problems, and sharing experiences with them, should be a necessity for every freshman engineer. College friendships and teamwork will not only make the next five years more enjoyable, but will pay career dividends in terms of human understanding and leadership skill.

Finally, developing humility will give overall meaning to the next five years and a realistic perspective for the future. Every freshman engineer should be aware of how little he knows about the complex field he has chosen as his vocation. But as his knowledge increases during his undergraduate years, the student should be even more aware of the great complexity and implications of his specialty, as well as the extensiveness of other areas of man's endeavor.

If this year's freshmen conscientiously spend their time wisely, ask questions, and cultivate intellectual humility, in 1962 they will realize they possess only tools and the ability to plan. They will know that to build in life requires using their knowledge to serve human need. If 1962's engineering graduates act on this realization, they will have made the most of their five years at Cornell. R.G.B.



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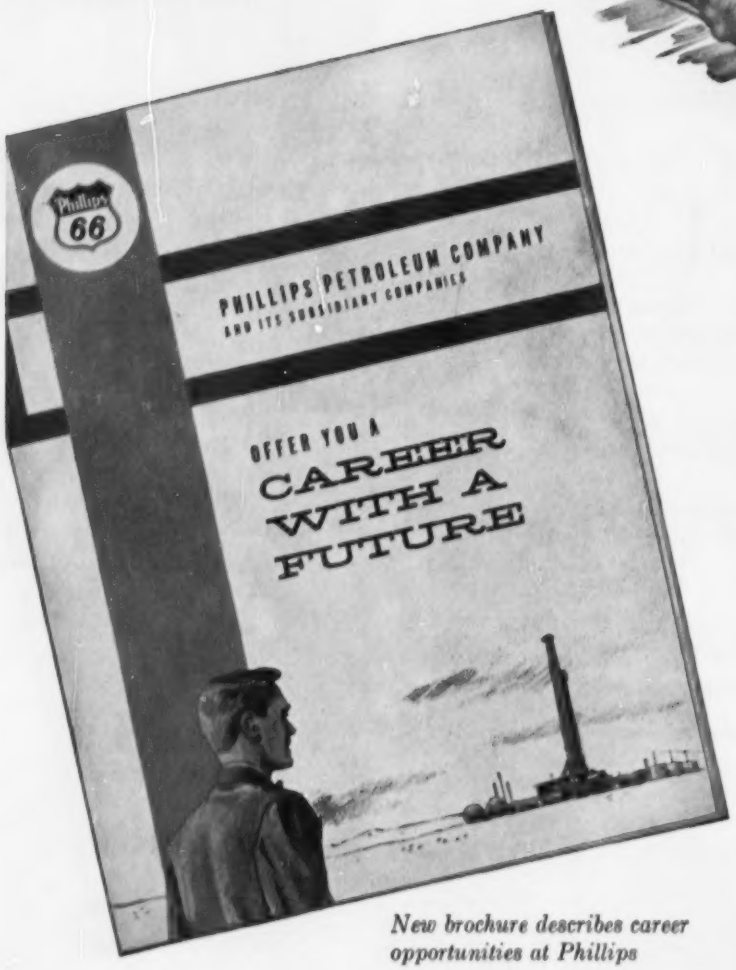

New brochure describes career opportunities at Phillips

This new booklet describes in detail the unusually fine career opportunities at Phillips Petroleum Company—the growth leader among America's integrated oil companies. New projects and expansion programs at Phillips have created many attractive openings for young men in practically every company operation.

At Phillips, the production of crude oil, the refining and marketing of automotive and aircraft fuels and lubricants continue to grow. Phillips is also in the forefront of the great boom in petrochemicals, sparked by a constant stream of new developments in synthetic rubber, plastics, carbon black, fertilizers and other chemical products originating in Phillips research labs. Less publicized Phillips projects include research, development and production programs in the atomic energy and rocket fuels field . . . as well as uranium mining and processing. Phillips is also the number one producer-marketer of natural gas and liquefied petroleum gas in the nation.

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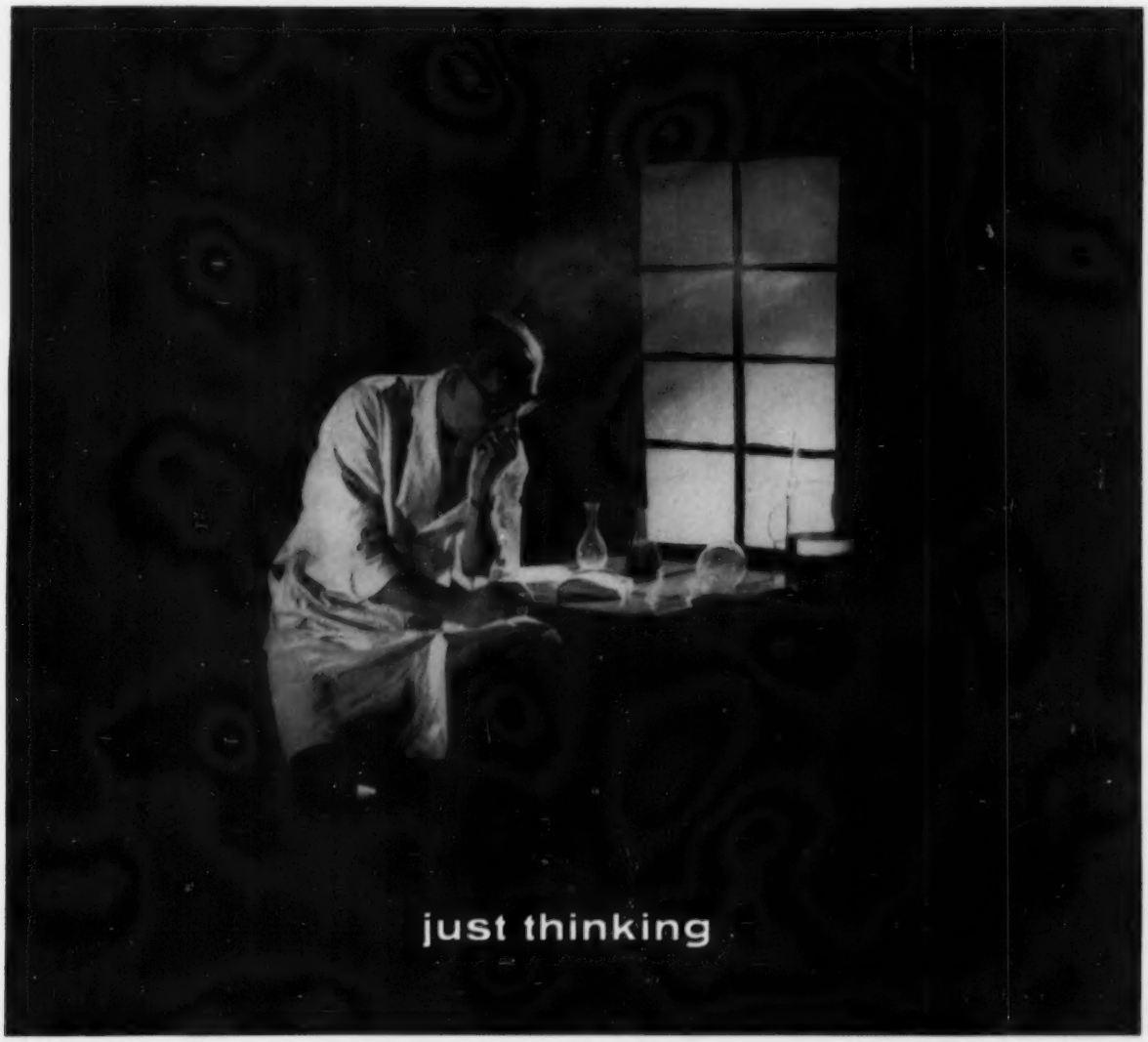

Chemical progress is autoclaves, test tubes, distillation towers . . . hydrocarbons, heterocyclic compounds . . . processes, polymerizations, products.

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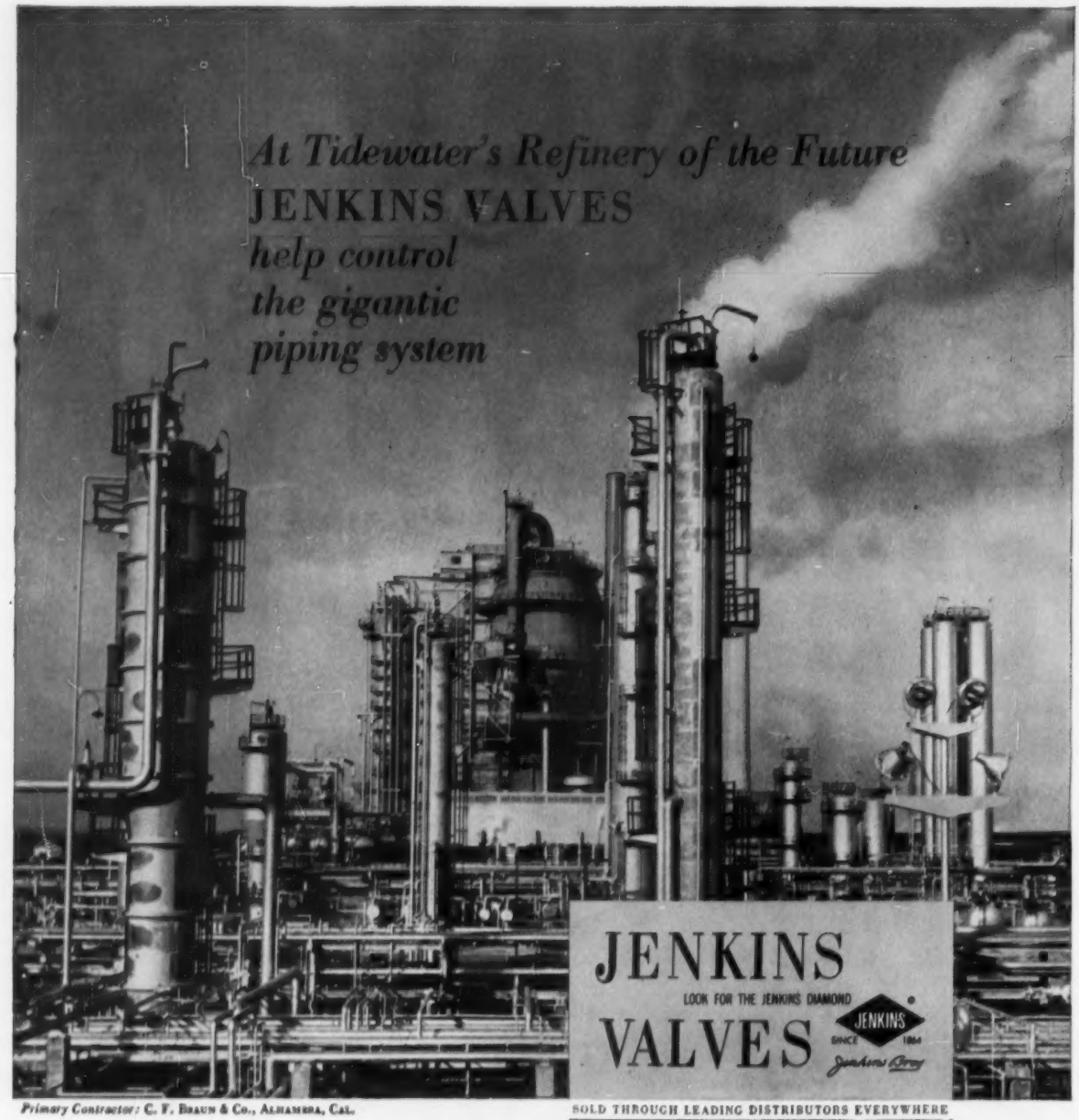

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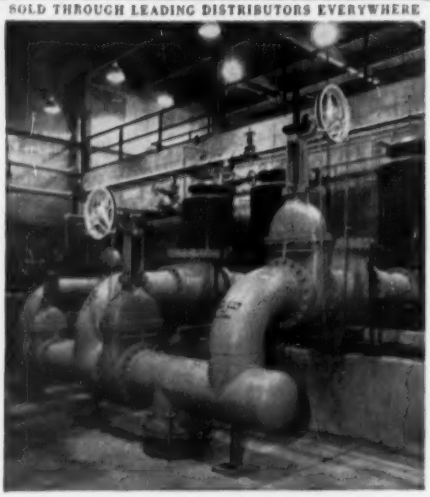

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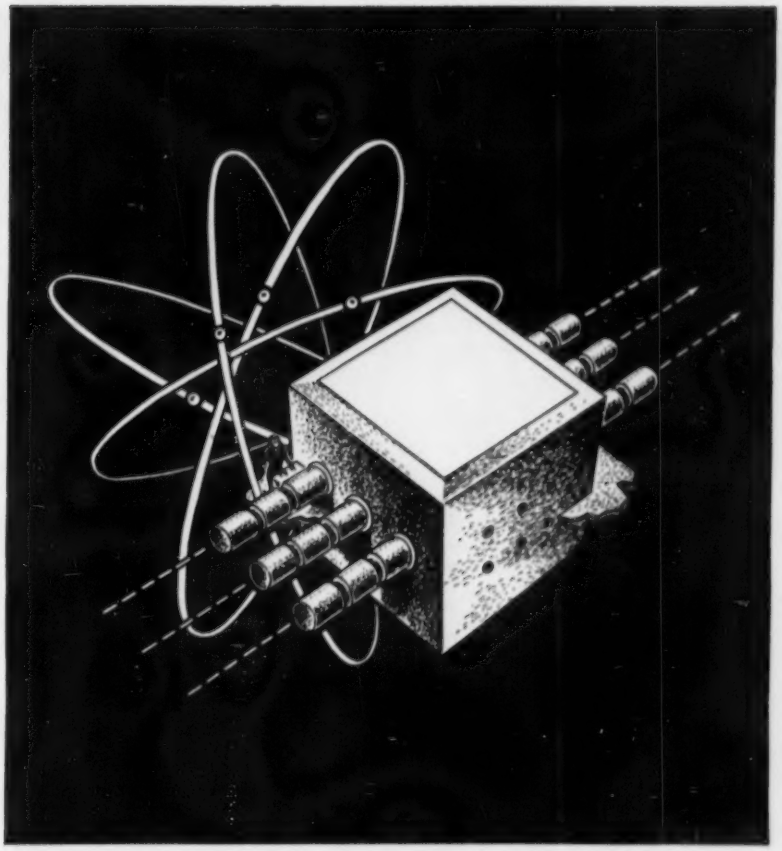

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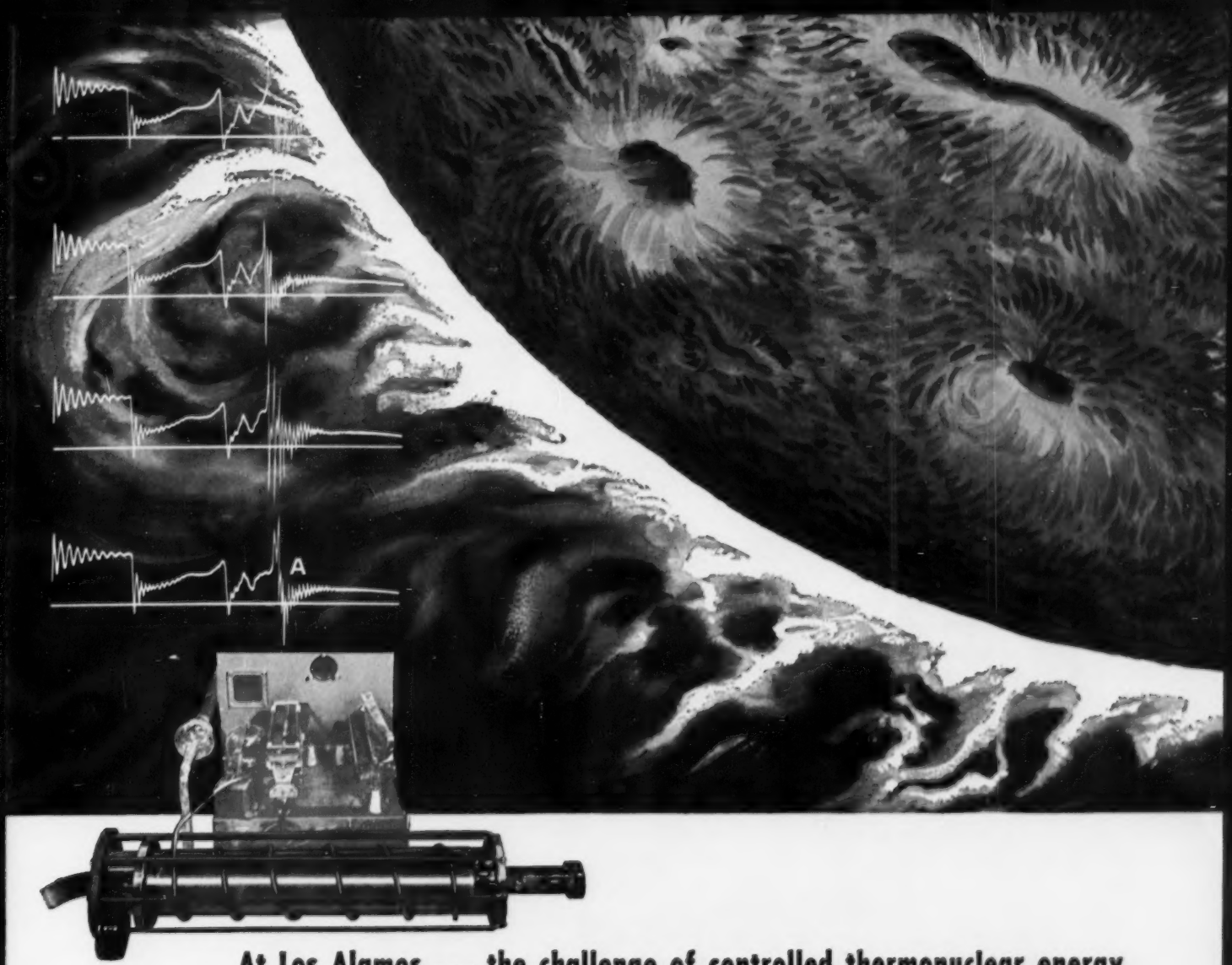

At Los Alamos . . . the challenge of controlled thermonuclear energy

The controlled release of fusion energy in a practical thermonuclear reactor will be an important milestone in the nuclear age. This scientific achievement is the object of PROJECT SHERWOOD . . . one of the interesting scientific investigations now under way at Los Alamos Scientific Laboratory.

Pictured above is "Columbus 1," an early experimental device developed by Los Alamos scientists to further this study. The bright line along the axis of the tube was produced by a discharge in heated and highly conducting argon gas. This discharge was "pinched" down to a small fraction of the tube diameter by the mutual attraction of its own currents. The temperature was roughly equal to that of the sun's photosphere. When deuterium was substituted for argon, intense bursts of neutrons appeared at time A on the voltage time signatures of the pinch (above, left), providing an interesting puzzle as to their origin. The similar signatures of successive discharges indicate the degree of reproducibility that has been achieved. Detailed studies of such reproducible behavior have led to considerable advances in understanding both the dynamics and the means for stable containment of heated plasmas.

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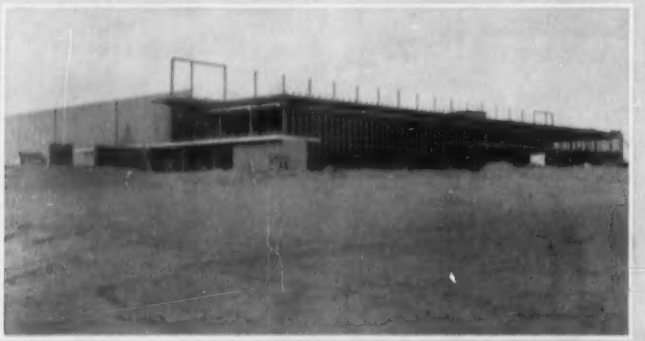
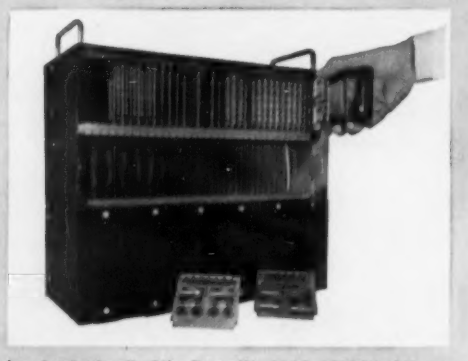
Data Reduction Center designed and built by Ramo-Wooldridge

One of three new research and development buildings completed this year



First unit of Denver manufacturing plant now nearing completion



Input-output unit of the Ramo-Wooldridge RW-30 airborne digital computer

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The photographs above illustrate some of the recent developments at Ramo-Wooldridge, both in facilities and in products. Work is in progress on a wide variety of projects, and positions are available for scientists and engineers in the following fields of current activity:

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Airborne Electronic and Control Systems
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Guided Missile Research and Development
Automation and Data Processing
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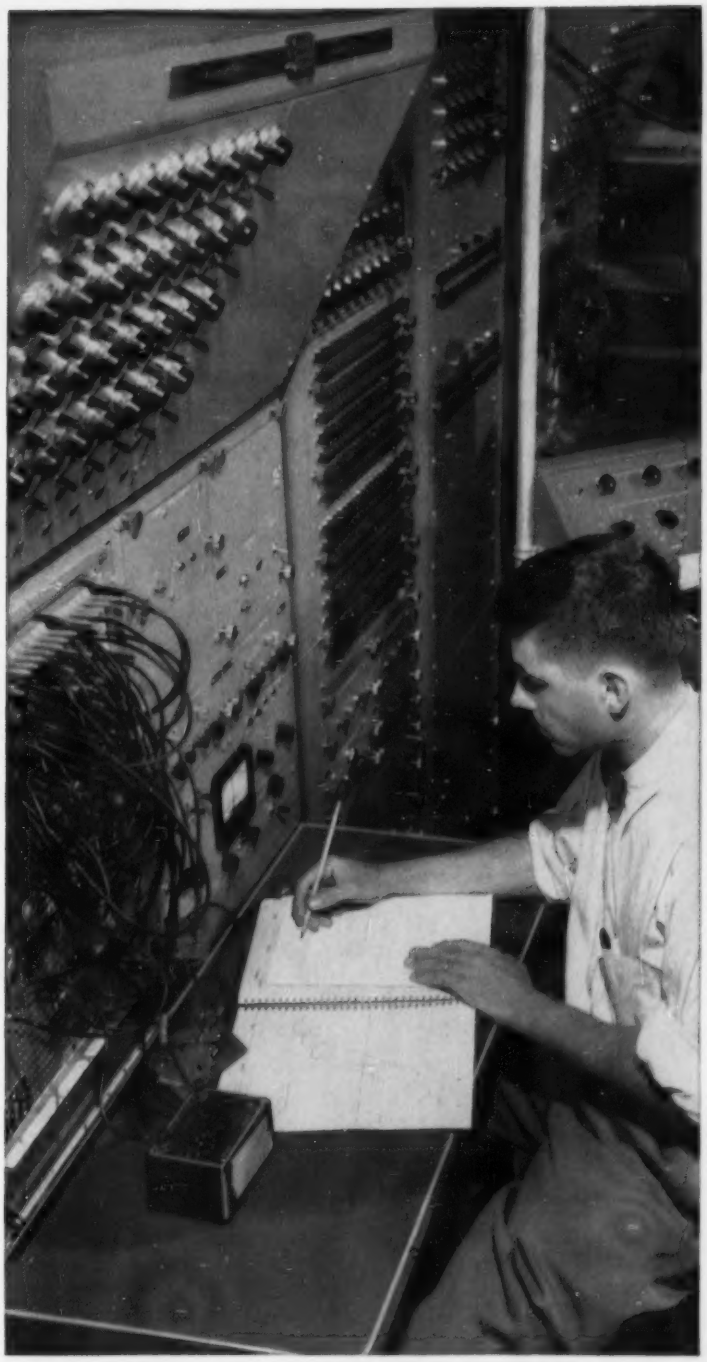

Can your imagination identify the problems being solved by this young Sperry engineer? Whether your guess is right or wrong, there's no question that at Sperry "imagineering" is the order of the day.

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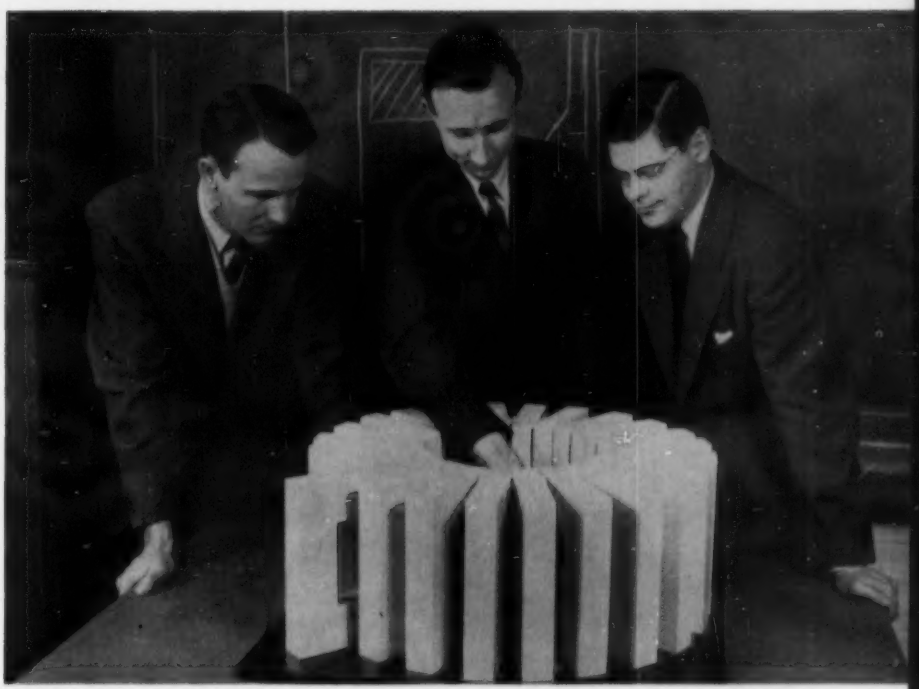


Professors Corson, McDaniel, and Wilson inspect a model of the magnet for the 300 MeV sunchrotron.

PIONEER IN NUCLEAR RESEARCH

by
William B. Easton, EP '60

The year 1934 marked the beginning of nuclear research at Cornell University. In that year, M. Stanley Livingston, co-inventor of the cyclotron, came to Cornell and, with the support of Professor Gibbs, then head of the Physics Department at Cornell, constructed the University's first nuclear accelerator. This cyclotron, with "dees" seventeen inches in diameter, could accelerate protons and deuterons to energies of up to one and one half million electron volts. One of the first machines built to accelerate atomic nuclei, the Cornell cyclotron is said to have "produced more research per pound of iron than any other machine ever built."

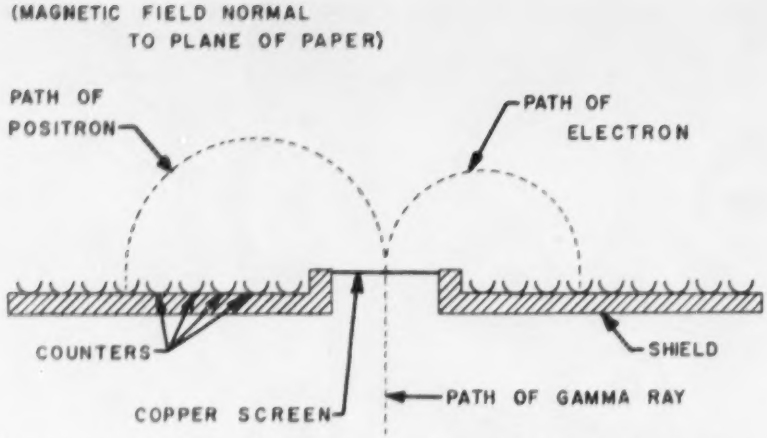
Professor Boyce McDaniel adjusts the arc source of the Cornell cyclotron. Many significant discoveries were made with this machine both before and after the Second World War.

Even with its age, small size, and low energy, the cyclotron is still used for research. Housed in the basement of Rockefeller Hall until 1956, it was used almost continuously until that time, when it was shipped to the Hebrew University in Israel. Until the construction of the synchrotron in 1947, it was the principal tool for atomic research at the University.

Among the earlier work done with the cyclotron were range and ionization measurements of protons and deuterons by R. F. Bacher and Marshal Holloway. Bacher, now Director of the Norman Bridge Laboratory at the California Institute of Technology, was on the first Atomic Energy Commission and had the over-all responsibility for atomic bomb assembly at Los Alamos. Holloway, a student of Bacher, was later connected with the Eniwetok tests and, until recently, was head of Lincoln Laboratories in Boston.

In 1937, Bacher, Livingston, and Dr. Hans A. Bethe, wrote a series of classic articles for *Reviews of Modern Physics*. These articles, which took up nearly all of three issues, were the "Bible" of the field of modern physics for the following decade.

In 1938, the best early measurements of neutron velocities were made at Cornell by the time-of-flight method. In this work, the cyclotron source was pulse modulated, so that neutrons were produced in bursts. The velocity of the neu-

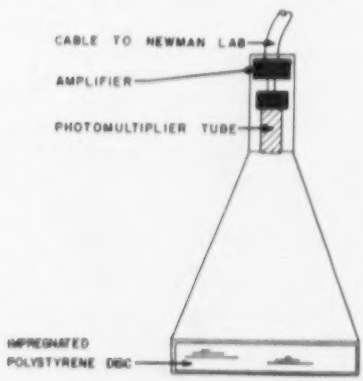


Apparatus for measurement of gamma-ray energies. The electron and positron produced when the ray hits the screen are bent into a circular path by the magnetic field. The energy of the ray can then be computed from the radii of the paths.

tron bursts was then calculated from the time of flight over a measured distance. The purpose of this experiment was to detect selective absorption of neutrons *(i.e.,* absorption of neutrons of certain energies on passing through a thin layer of a given material). In 1940, a project for measurement of neutron velocities, farmed out from the Manhattan project, was carried on by Professors Charles P. Baker and Boyce D. McDaniel at Cornell.

In the three years following the attack on Pearl Harbor, most of the atomic physicists in the United States, including those at Cornell, went to Los Alamos with the Manhattan project to work on the atomic bomb. The slow-neutron velocity spectrometer used in the above work was taken to Los Alamos and used in the first measurements of neutron absorption cross sections for Uranium and Plutonium for neutron energies up to 1000 electron volts.

An interesting story is connected with the unit used for such cross sections, the *barn,* which is equal to 10^{-24} square centimeters. While working on the Manhattan project, Baker and Holloway were measuring an absorption cross section which was expected to be about 10^{-28} cm^2, but which turned out to be nearer 10^{-24} cm^2. One of the men promptly remarked, "Gee, that's as big as a barn!"—thus the name.



Scintillator can. Particles in cosmic rays cause the emission of light in the impregnated plastic, which in turn activates the photomultiplier tube.

The Return From Los Alamos

In 1946, many of the men who had gone to Los Alamos returned to Cornell, along with a number of new ones. At this time, the Department of Nuclear Studies was created and placed under the direction of Professor Bacher.

At this time, it was decided that an electron accelerator of higher energy than the cyclotron was necessary for future research projects. In 1947, construction of a 300 million electron volt electron synchrotron was begun under the direction of Professor Bacher, with funds provided by the Department of the Navy.

An early project which made use of the new synchrotron was the measurement of gamma-ray energies. This experiment, carried out by Professor McDaniel, provided the first absorption measurements of gamma rays to 25 MeV with good resolution. As shown in the diagram, the photon on hitting a copper screen, produces a positron and an electron. These two particles are then bent by a magnetic field into circular trajectories, the sum of whose radii is proportional to the gamma ray energy.

Another pioneering experiment was the determination of cross section for production of neutral mesons and a study of other meson production processes. Neutral π-mesons are produced by the interaction of gamma rays with protons. In these experiments, performed by Silverman and Stern, the mesons were detected by measuring the gamma rays produced on their decay. At the same time, cross sections for postive π-mesons were measured by other groups.

In 1953, construction was started on a new synchrotron which would accelerate electrons up to energies of 1.5 billion electron volts. This project was under the direction of Professor Wilson, director of the department since Professor Bacher's departure in 1947. Six months later, the old machine was retired.

In the new synchrotron, electrons with energies of 2 MeV are injected by a Van de Graaf generator into the "donut," an evacuated glass tube approximately twenty-five feet in diameter. The Van de Graaf source is pulse modulated so that electrons are injected thirty times per second for a period of 10^{-7} seconds.

The synchrotron field coils are fed by thirty-cycle alternating current, so that the magnetic field changes form approximately 20 gauss at injection to a maximum of 10,000 gauss in one-sixtieth of a second. With a large change in the magnetic field, it is evident that eddy currents and hysterisis will produce large deviations from the desired path of the electrons. The present cyclotron is, therefore, a "strong-focusing" machine, in order to overcome such errors. In a strong-focusing machine, the pole pieces of the field magnet, which are shaped to act on the beam of electrons much as a lens would on a beam of light, are made alternately convergent and divergent, but on the average strongly convergent.

The old 300 MeV synchrotron, now retired from use, still stands in the center of its successor's donut. The field coils of the old machine are used as a choke coil to separate

the AC field supply from the DC bias supply also used.

The electrons, when injected into the donut have already reached approximately 98 per cent of the velocity of light, so that most of the added energy goes into increasing the mass of the particles by a factor of several thousand. In the one-sixtieth of a second during which the electron is accelerated, it travels around the donut a distance of over three thousand miles, the distance from Ithaca to London, England.

Theoretical Physics

The aims of nuclear research before the Second World War were to discover the structure of the nucleus, to study the mechanism of nuclear reactions, and to find out the effects of a collision of an arbitrary particle with an arbitrary nucleus. Experimental work of this period was limited to that which could be done with a low-energy machine (less than 15 MeV); theoretical physicists, who must work closely with the experimenters, were likewise limited to this range.

In 1935, Dr. Niels Bohr proposed the compound nucleus theory: when two nuclei collide, they combine to form a new nucleus which "forgets" completely how it was formed. The new nucleus may then disintegrate or fission to form any products for which it has sufficient energy. This theory was found later to be nearly correct.

It was also found that in quantum mechanics a particle could penetrate the so-called "potential barrier" of a nucleus even though its energy might not be high enough according to classical theory.

These two theories formed the basis of the theory proposed in 1938 by Dr. Hans Bethe on energy production in stars. A study of the reactions of Dr. Bethe's theory was made on the Cornell cyclotron by Dr. Holloway, whose work permitted refinements in the calculations of the theory.

Energy production in stars is still being studied both here and elsewhere. Dr. Salpeter, of Cornell, has been interested in this field for the last five years, and has made various discoveries about reactions in stars hotter than the sun. It has been found that a star which has used up its hydrogen can often continue by "burning" its helium.

It was found by Dr. Bohr that the nucleus itself has different quantum states. The spacing of these quantum states as a function of energy was calculated by Dr. Bethe.

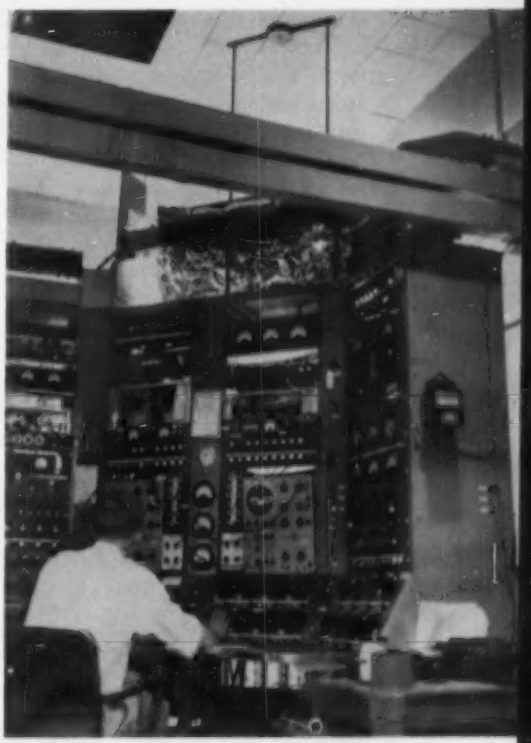
The work of Dr. Bethe and Dr. Placzek in conjunction with the neutron velocity spectrometer previously mentioned contributed greatly to the knowledge of the properties of slow neutrons. This information was soon to be useful for the Manhattan Project.

The year 1938 marked the discovery of the μ-meson. It had been suggested in 1935 by Dr. Yukawa that there should be some sort of particle which transmits nuclear forces between nucleons. In 1939-41 Dr. Bethe wrote a series of papers on the forces between nucleons. These papers, however, are now obsolete, due to the discovery of the π-meson in 1947.

Following the discovery of the π-meson, Professors Walker and Littauer carried out experiments on cross-sections for production of positive and negative π-mesons. It was expected that the cross section would be the same for both particles when an element whose atom contains equal numbers of protons and neutrons. It was found, however, that the ratio of negative to positive mesons was close to seven. A ratio of 1.3 could be explained, but not a ratio of seven. The ratio decreased from seven for lighter nuclei to 1.3 for $_{20}Ca^{40}$, the heaviest stable nucleus with equal numbers of protons and neutrons. An explanation for this effect was given by Mr. MacVoy, a graduate student at Cornell.

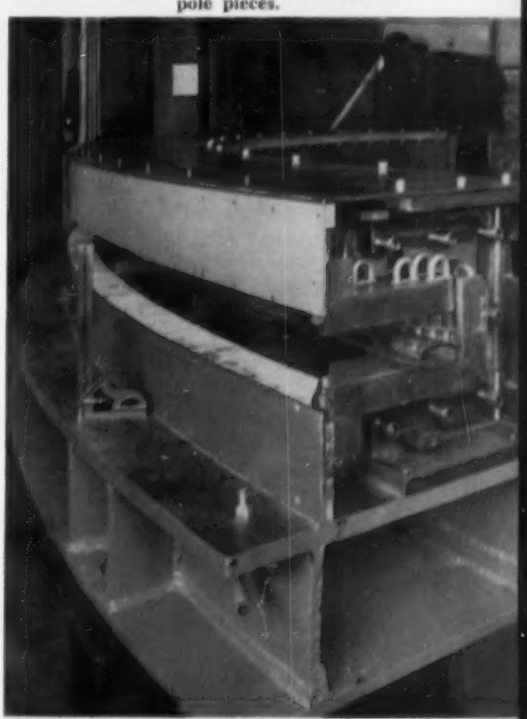
It had been predicted that the production cross section of π-mesons should rise with the energy of the gamma rays, but it was found that the curve reaches a maximum and then drops to a much lower value, much as the response curve of a resonant circuit. It was suggested that it was, in fact, some sort of resonance. Work is still being done on the theory of this resonance.

It has been known for the last ten years that the nucleus of an atom is constructed somewhat like the electron shells, rather than being a solid mass. Much information has been gathered on the quantum states and shells of the nucleus.



Control room of the 1.5 BeV Cornell electron synchrotron

Section of the 1.5 BeV synchrotron during construction. Notice the glass "donut" and magnetic pole pieces.



It may be shown by mathematical methods that the energy contained in the field of a point charge is infinite! Various men have worked on this apparent paradox, and three solutions have been proposed. Of these, that of Dr. Feynman, formerly of Cornell, is the simplest and best. Dr. Bethe also did a "little calculation" on this problem.

Present studies include the so-called "strange particles," which include the k-meson, with half the mass of a proton, and "hyperons," with mass greater than that of a proton. These are being studied here by Professor McDaniel.

Cosmic Ray Research

Cosmic ray research started at Cornell in 1940 when Bruno Rossi, an Italian refugee, came to the University. After first going to Chicago University to work with Professor Arthur Compton, Rossi came to Cornell, bringing his considerable background in cosmic ray work. With Mr. K. I. Greisen as his first graduate student, Rossi's cosmic ray work continued until 1942 when Rossi and Greisen went to MIT and Los Alamos, respectively, for war work.

During the three years following 1940, various experiments were performed, including measurements of the lifetime of the μ -meson and the intensity of electrons and mesons in cosmic rays. In 1946, Rossi remained at MIT, but Greisen returned to Cornell as a professor. The following year, Mr. and Mrs. Cocconi came to the University to do cosmic ray work. In the years that followed, extensive work was done with neutrons in cosmic rays and extensive air showers. In 1950 to 1953, measurements taken 2,250 feet underground in the Cayuga Rock Salt Company mine afforded much information about absorption of cosmic rays by the Earth's crust.

At present, there are two major projects for the study of cosmic rays, both under the direction of Professor Greisen. Behind Newman Laboratory is a trailer containing various detection equipment, including a bank of counters used to measure the curvature of the paths of charged particles in a magnetic field. From the data thus obtained, the energy of the particles can be computed.

Situated at various points on campus are fifteen large white cans containing scintillators for the study of extensive air showers, *i.e.*, showers of cosmic rays which fall over a large area. These showers are produced by the interaction of a primary particle with atoms of the atmosphere to produce up to one hundred thousand secondary particles.

About half of the scintillators are situated within a few hundred feet of Newman Laboratory, while the others are placed up to a half-mile away.

As shown in the diagram, the cans contain a large disc of polystyrene impregnated with special ingredients, terphenyl and "POPOP." Cosmic ray particles striking the terphenyl cause it to emit light. The POPOP absorbs this light and emits light of a higher wavelength, which actuates the photomultiplier tube.

The data thus obtained are analyzed by computers in Newman to find the angle of elevation of the shower, the location of its center, and other pertinent information.

The nuclear research which Cornell has done and is doing is an attempt to push back the frontiers of human knowledge and to discover the secrets locked within every atom.

The Cornell 300 MeV electron synchrotron. The "Donut" is inside the magnetic pole pieces.

THE GROWTH OF PACKAGING FILMS

by

Herbert Senz, ChE '57

Of all the manufacturer's problems, one of the biggest is that of making his product attractive enough to entice his customer. The customer that often proves hardest to please is "Mrs. Housewife." Each year the producer must sell more and more items to that unpredictable lady with the shopping basket.

One of the most effective ways of attracting attention to one's product is an effective packaging technique. It is this important selling point that has resulted in the skyrocketing activity in the packaging film industry. Packaging films not only provide a convenient and inexpensive container, but also permit the customer to see just what he is buying. These advantages have resulted in a tremendous boom in the packaging industry since World War II.

Profitability

The packaging industry is large with several phases of production. First there is the supplier who provides the basic chemicals and ingredients for the process. Then there is the converter who prints, laminates, or makes bags from the film. Finally there is the actual manufacturer of the transparent product.

The supplier of materials for the industry need not be a specialist in the field of packaging films. He may sell his products to textile manufacturers, paint makers, etc. Consequently, he may do a profitable business without the help of film manufacturers.

The converter, on the other hand, is operating in a cut-throat field. There are approximately 250 film converters. In 1955, a study of about 40 converters revealed a net profit of 1.77% before taxes which is highly inadequate considering the risks and the investment requirements. The high point for converter profits was in 1951 with 10.14%. Since that year, the best performance was in 1953 with 3.52%, 1952 saw 1.59% and 1954 had 1.58%.

There are several reasons for the number of small film converters. One of them is the fact that the investment required is relatively low. In addition, a number of the firms making equipment will sell the equipment on a time basis. Also, the technology required is not highly complicated and the free technical service supplied by the resin-producing companies simplifies mat-

ters even more. The net result is that entering the business is fairly easy, and new companies are formed almost daily while an equal number fall by the wayside.

From this analysis, it would appear more profitable to enter the packaging field at the primary level, but here, published financial statements do not isolate individual product performance.

The large capital outlay of $30,000,000 for the economic running of a cellophane plant would prevent any but the larger companies from entering the field. Present capacity of cellophane is about 450 million lbs. per year. The present consumption of the film is an estimated 400 million pounds, and is not expected to reach 450 million pounds until 1960.

In addition to the large capital investment required to enter the cellophane business, a company could not expect a high initial return on this investment. It takes time and experience to get the operation into optimum running order. It would also require a very extensive sales program to take any significant part of the market away from the present producers of the film.

By the end of 1957, the total polyethylene capacity will be an estimated 860 million pounds per year. The total consumption at this time will be around 530 million pounds. Assuming no further expansions, the consumptions of polyethylene will not equal the capacity until 1962. The ever-intensifying competitive situation is expected to reach a climax in 1957 or 1958. About 30% of the total consumption is in packaging film.

Over production is not, of course, particularly unusual for a new material with untested potential, but in polyethylene's case there are three considerations that make excess capacity of particular consequence. One is economic, the second technological, and the third is commercial:

1) Polyethylene equipment is massive, expensive, and of no value to any other presently commercial process. This makes idle polyethylene capacity a heavy burden on any corporate books.

2) In the polyethylene process, product quality is elusively unpredictable. Even the slightest lack of processing control will swing the product far off specifications, resulting in a valueless wax instead of a salable plastic.

3) The seriousness of the quality problem is aggravated by the fact that polyethylene, being a plastic, will reach the public only through the hands of the plastic processors —the film extruders, injection molders, and wire coaters—who have historically been infested and undermined by fly-by-nights and quick-dollar operators. The market researcher's nightmare is that a soured public might flatten the sales curve now projected for polyethylene, leaving the industry in an overproduced position for a decade instead of a few years.

Mergers for Reduced Costs

The recent merger between Visking Corporation and Union Carbide has been aimed at greater profitability. Visking is generally credited with producing well over half of all the polyethylene film manufactured in the United States. Union Carbide is the largest manufacturer of polyethylene resin.

It may be that both Visking and Carbide management saw a threat in the growing trend toward integration of producer, distributor, and processor and moved accordingly to meet such competition. This threat took the form of such mergers as the Koppers purchase of Durethene (a large film producer), and the merger, yet unpublicized of a resin producer, a nationwide distributor, and a western extrusion firm. Such a three-way organization could be quite formidable. There are also various captive polyethylene film plants that are controlled and owned by huge corporations which are well able to withstand vigorous competition.

Cellulose acetate is produced by several companies. Eastman Kodak produces the packaging film as a by-product of its photographic film business. The total consumption of cellulose acetate in packaging uses is about 5 million pounds a year. All the foreseeable growth will be taken up easily by the present producers of cellulose acetate.

Very little, if any, clear polyvinyl chloride film is being used as a single film for packaging applications. Significant growth is not expected in the packaging field.

It is expected that Du Pont's Mylar polyester film, because of its unique properties and great strength will see the most growth and divergence of applications among the more recently introduced films. At present, the cost of Mylar is high compared to the other films on the market. The total estimated use of polyester film in packaging in 1956 was less than 3 million pounds. The high margin of

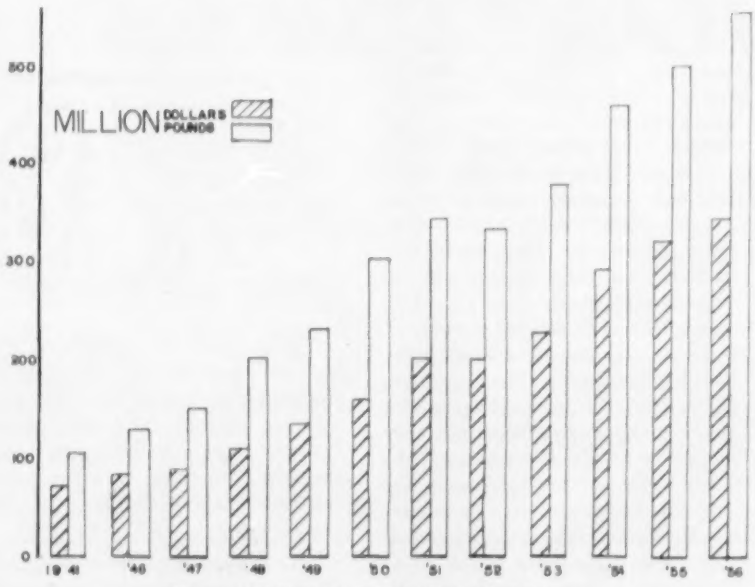


Figure 1. Estimated Sales of Packaging Film.

profit, however, makes it a high profit material. With increased consumption, the price of the material is expected to drop, resulting in even greater consumption of the material.

Saran, like Mylar, has a relatively low consumption rate, but has a relatively high profit margin. The largest use for the Saran film is in the wrapping of foods in the home.

Goodyear's Pliofilm, one of the earliest flexible film contenders, has been a comparatively slow mover in the packaging market. Although there are no actual production and consumption figures available, use in packaging probably doesn't exceed 15 million pounds per year. The profit margin is probably considerably higher than cellophane but lower than Mylar.

Unusual Expansion

The growth of the film packaging market has been somewhat spectacular since World War II. Development of new films as well as continued research of packaging methods have corrected many of the previous misapplications of films for packaging purposes. Although the growth of plastic film packages has been rapid, surveys made by the Department of Commerce showed a virtually unanimous belief that the major growth lies in the broad and extensive undeveloped areas of the future.

The growth pattern of transparent flexible plastic films for packaging is shown in Figures 1 and 2. Probably the most significant strides of the industry have occurred since the World War II government controls and mandatory restrictions were revoked.

The United States Department of Commerce Field Office surveys revealed that generally the post World War II growth of packaging film was consistent for all segments of business, i.e., manufacturing, converting, wholesaling and retailing, as well as for all geographical areas of the country.

Current U.S. sales of flexible packaging film are estimated at some 550 million pounds per year, worth something over $300,000,000. By 1960 consumption will likely hit close to 700 million pounds, more than double the 347 million pounds sold in 1951. By 1965 sales of these flexible films will probably reach, or even exceed, the billion pounds per year mark.

Although other types of transparent, semitransparent, and opaque materials are providing some sharp competition for a number of once exclusive cellophane outlets, the latter's future seems to contain the same assurance of growth that has characterized it in the past.

Within the next four years, plant refinements, improvements in production methods, and new plants will boost annual U.S. cellophane output to a near-500 million pounds. Thereafter, the production rate should move up steadily and come close to 600 million pounds per year by 1965.

In a two-year period, polyethylene film for packaging has increased almost four-fold from an estimated 28 million pounds in 1953 to approximately 97 million pounds in 1955 (representing about 75% of the estimated 130 million pound total polyethylene film production). Predictions for 1960 indicate a possible 300 million pound production of polyethylene film with 225 million pounds in the packaging market alone.

As can be seen from Figure 2 polyethylene has not disturbed the market for cellophane to a great extent.

According to trade estimates, two years ago about 8 million pounds of cellophane were used for

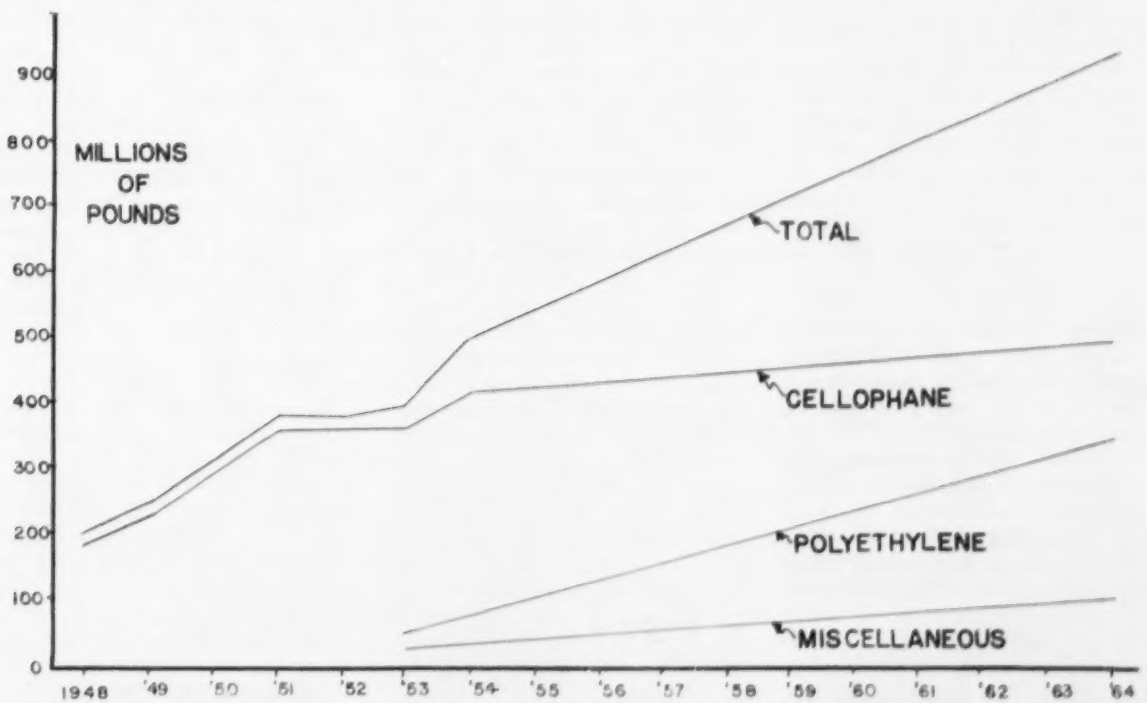


Figure 2. Estimated U.S. packaging film output with projected trend lines to 1965.

Figure 3. End use pattern for packaging films (est. 1957).

Figure 4.
End-use pattern of Aluminum Foil for packaging.

produce packaging; by now the rate probably tops 10 million pounds per year. As recently as 1953, polyethylene used for this purpose totaled about 6 million pounds, and by 1955 consumption had climbed to an estimated 20 million pounds per year rate.

Use Trends

The estimated end-use pattern predicted for packaging film in 1957 is given in Figure 3.

At present, the wrapping of baked goods accounts for about 30% of the packaging film produced. This, however, is not the area of greatest growth potential.

Nearly 100% of film wrappings for baked goods are of cellophane. Although it is predicted that the use of cellophane for baked products will increase from about 120,000,000 pounds to 150,000,000 pounds in five years, this falls far short of the expected 45% estimated increase in the total production of packaging film within this period.

The meat and poultry outlet for films, although presently accounting for only about 16% of the total packaging film production, is wide open for large expansions. There are approximately 17 billion pounds of meat consumed annually in this country, but only about 5 billion pounds are now being packaged in transparent film, requiring about 65 million pounds of film.

Of the 2.5 billion pounds of fresh poultry consumed each year, some 860 million pounds are plastic-wrapped, providing an estimated 8 million pounds per year market for film. In addition, frozen poultry, about 20% of all sales, takes about 1.5 million pounds of packaging film and appears to be well on the way to requiring double that amount.

Thus, with only 30% of the meat and about 35% of the poultry currently being wrapped in film, it is apparent that such usage has a great potential.

It is in the packaging of fresh fruits and vegetables, however, that most film makers and converters expect the biggest advances. About 10% of the packaging film produced is used to package fresh produce.

The Department of Agriculture recently estimated that only about 15% of the 75 billion pounds of produce grown each year in the U.S. are now bagged, trayed, overwrapped or otherwise packaged. Only about 7% is prepackaged in plastic film. The marketing director of one of the world's largest food-store chains, predicts that in ten years, more than 75% of all fresh fruits and vegetables will be prepackaged at grower, terminal, or retail level. Other marketers say this percentage will be reached in half the time.

Film use for such purposes is definitely moving upward. In 1950 about 12 million pounds were used in produce packaging; by 1953 consumption had risen some 65%; and in 1955, use with fresh fruits and vegetables was about 40 million. A tripling in the next decade or so is not out of line.

Prepackaging is done by all levels of distribution: the grower, the terminal shipper, service wholesaler, and the retail outlet. A report on packaging at the farm level from the Market Growers' Journal shows that 20% of the farms contacted indicate that their crops are now prepackaged for retail sale, and an additional 17% have plans to prepackage in the future. Based on this same study, current annual expenditures for plastic packages average $1,618 per farm and represent 39% of the bagging materials used. In addition, cellophane accounts for 22% of the bagging materials. If this $1,618 were projected on a national basis, it would represent over $5.5 million of plastic film purchase in this area alone.

Some of the large supermarkets are establishing their own packaging plants which they have found more economical than having produce packaged at each retail outlet. One supermarket chain now has eight plants where fruits and vegetables are prepared and there are more of these plants in the planning stage.

To "See What They Buy"

The importance of packaging in catching the consumer dollar can be gauged by the results of a survey on consumer shopping habits in supermarkets carried on by DuPont. It was found that 48% of all supermarkets purchases are made on impulse without any previous plan and 70.8% of all supermarket purchases are buying decisions made inside the store. Of all cellophane packaged items purchased 77.2% were a result of store decisions as compared to 70.8% for all items in all types of packages. This points to the conclusion that shoppers like to see what they buy.

However, the rate of impulse sales varies among different food categories. For example 46.2% of all canned fruit and vegetables purchased are unplanned, while the same survey shows that on 32.4% of all fresh fruit and vegetable purchases are unplanned. The delays encountered in the purchasing of fresh produce discourage impulse buying. In a typical service produce department the customer must wait in line to be served, wait for the produce to be weighed, wait for wrapping and wait for price marking. These are common delays which make produce buying difficult. Pre-packaging with transparent flexible films is the key to self-service. Pre-packaging eliminates the wait for clerk help and converts loose commodities into price marked, self-service units. The DuPont survey showed that the average shopper passes through the self-service produce department in 24% less time but buys 16% more in this time.

The trends toward self-service in non-food merchandising is also a potential large market for packaging films.

There are some 35,000 hardware stores in the United States today, and there is a growing trend to self service. A survey by the National Retail Hardware Association during 1955 showed one out of seven independent hardware stores had put in a check-out counter. Still another 15% are planning to convert to check out. The toughness of polyethylene makes it especially suitable for packaging many heavy items such as nuts, bolts and even tools in the hardware stores. It is also well-suited to bulk gardening supplies, like grass seeds and plant food.

Most of the business in the 22,900 variety stores in the United States is being made up of the sale of many, many small items of merchandise. Woolworth, at the end of 1950, had approximately 400 self-service units. Most of the new stores to be opened in shopping centers will be on a self service basis throughout the variety field.

To date, self service has been adopted by the 10,600 department stores in the United States to only a small degree. Recent statistics indicate that operating expenses have cut department store profit margins. It seems inevitable that here, too, well packaged self-service items will be the answer to rising overhead and dwindling profits. Much of the lingerie, sweaters, toys, linens, etc. sold in department stores is being packaged in transparent film to increase turnover and to prevent costly mark downs due to damage caused by customer handling.

Competitive Products

Aluminum foil usage for packaging consumption is expected to grow along the lines of accelerated use in new applications rather than through any great buckling of transparent films. The growths of aluminum foil and packaging film have been about equally rapid. A comparison of production of film and foil for packaging use is given below:

Packaging Consumption in million pounds

	Aluminum foil (including laminations)	Packaging film
1953	86	88
1954	104	465
1955	135	500
1956	140	550
1965 (est)	200	1000

The estimated end-use pattern for aluminum foil is given in Figure 4. A comparison with the estimated end-use pattern for packaging film shows very little conflict in markets. The properties of the two types of materials lend themselves to different end-use patterns.

About 30% of the film produced now goes into the wrapping of baked goods compared to only about 4% for aluminum foil. About 44% of the aluminum foil produced for packaging goes into the wrapping of frozen foods where the extremely low water transmission of the foil prevents freezer burn in frozen foods. It is also in the frozen food market that the largest future growth in foil packaging is forseen.

In the packaging of such items as tobacco products and gum and confectionary, foil is often used as the inside wrap while film is used as the outside wrap so there is little competition here.

Paper products are also competitors of the clear packaging films. There are few official government statistics available on the various packaging papers. The trade, too, has revealed very little concerning the magnitude of its operations. It is estimated that future growth will be steady but will not come close to the growth of packaging film.

Output of the three leading papers is estimated at about 315 million pounds and is expected to grow to about 360 million pounds in 1965.

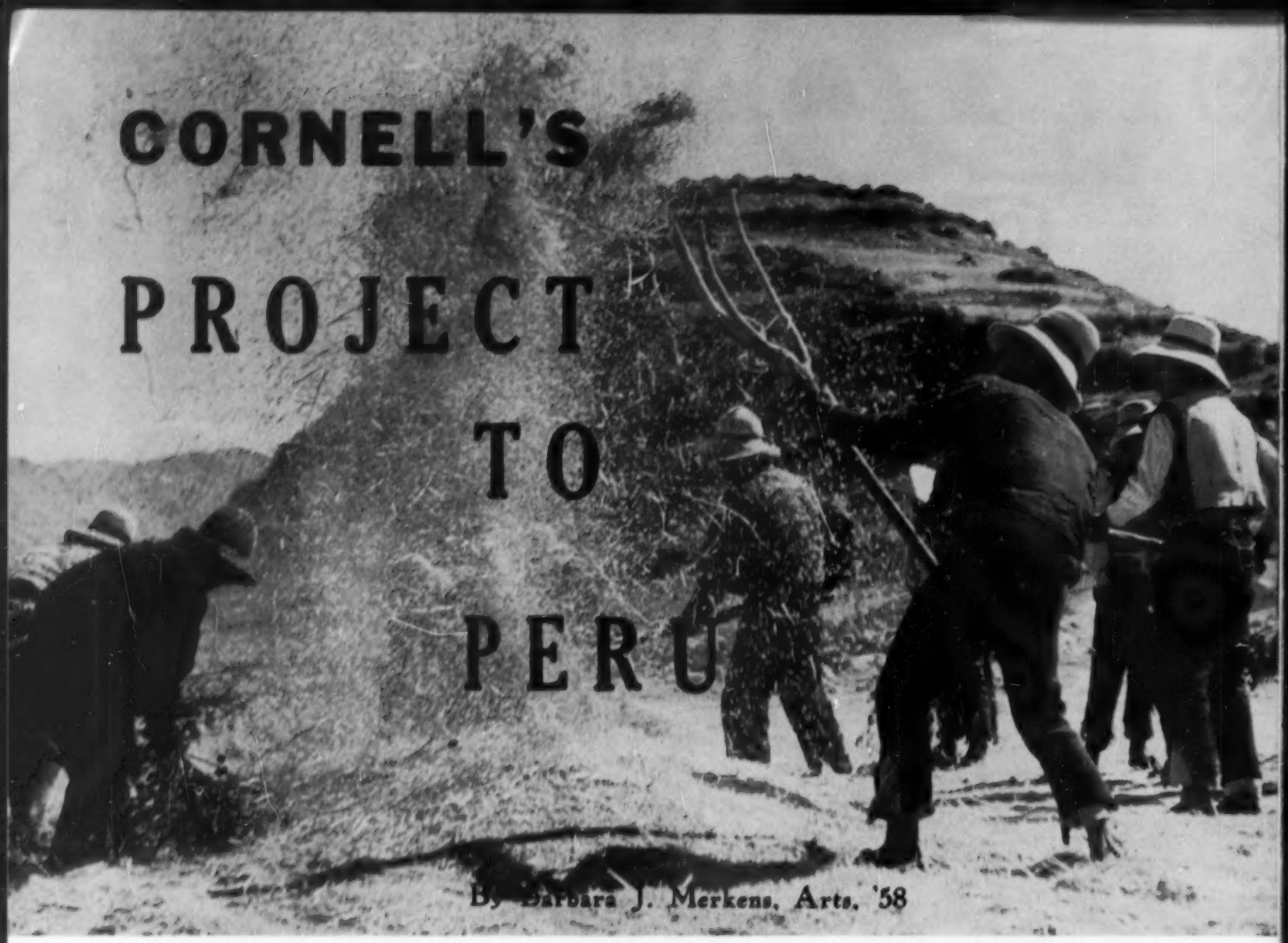
Although a number of paper products have been replaced by the newer packaging materials, paper will continue to be a formidable competitor for some markets.

Glassine is smooth and dense and is an excellent base sheet for coatings with special properties such as water vapor proofness and heat seal. One of the principal coatings is paraffin wax.

Greaseproof papers are also widely used in packaging food. Foil and films continue to move into this area, but the greaseproofs are still dominant in the packaging of lard, butter, margerine, ham, bacon and similar products.

While cellophane has made strides as a wrapper for white and specialty breads, waxed papers are still far ahead in total number of loaves packaged. In the packaging of cakes and baked sweet goods cellophane is rapidly overtaking the papers.

In the packaging of such foods as potato chips, popcorn and salted peanuts, papers still lead but within the last five years cellophane has moved in to take nearly a third of the market.



CORNELL'S PROJECT TO PERU

By Barbara J. Merkens, Arts, '58

Picture a backward community high in the Andes Mountains of Peru. The people are Indians living at a subsistence level. They raise potatoes, little knobs which often suffer from blight. The land is eroded, and agricultural methods are centuries old. Poverty paints the scene.

There is little contact with the outside world. The people are looked down upon and exploited by their neighbors, who are mestizos. Their thinking is contained within the bounds of the hacienda on which they live and work. Hence, they fear, even hate, anything that is not defined for them by the traditions of their community. They are dominated by a patron who rents the hacienda from the Peruvian government. However, the Indians would be helpless without the patron, for they are ignorant. They know only hunger, poverty, and disease and are resigned to a dull, meaningless struggle for existence.

This is the picture of Hacienda Vicos. Situated on the slopes of a valley niched in the Andes, the hacienda covers about 35,000 acres, most of which are rocky. There are 2,500 acres under cultivation and 4,000 acres used for grazing. These provide an income for the patron and support the 380 Indian families.

Enter the Cornell-Peru Project

Into this picture came the Cornell-Peru Project in 1952. The Project was an experiment in applied social science, directed by Allan R. Holmberg from Cornell's Department of Sociology and Anthropology. Scientists and skilled technicians were contributed by the Indigenous Institute of Peru and the Peruvian government. The Project was financed by the Carnegie Corporation of New York.

The purpose of the Project was two-fold. First, it was to introduce technological and social changes into a community centuries behind the times. Second, to observe the effects of these changes. It was believed that principles could be gleaned from this experience and applied to similar projects in other backward areas.

Cornell rented the hacienda for a five-year period. For months previous they had studied the community and its traditions. They intended to work with the framework of the Indian culture, alter-

Miss May Kedney, of Skidmore College, instructs an art class in the Hacienda Vicos school. Miss Kedney, a Professor of Education, was a member of Cornell's project to Peru in 1954, doing research on children's art.

Medical Clinic at Haciendo Vicos. Allan R. Holmberg, who directs the work here, is at far right, foreground. The doctor from the Peruvian Health Ministry, background, is checking Indian patients who have applied for out-patient treatment.

ing it gradually to meet the requirements imposed by technological change.

Agriculture Program

The Project concentrated on technological improvement in three areas: agriculture, education, and health. Agriculture, specifically the potato culture, provides the community with its living. When the scientists began their work, they found that a potato blight had ravaged the crop of the previous two years. The Indians had been reduced to eating seed grain; in desperation they stole. The Project introduced modern methods and implements, for if productivity were increased, the standard of living would rise.

The story of the Project's agricultural program reveals the striking results of a few simple improvements. The scientists launched the program with an offer of blight-resistant seed, insecticide, and fertilizer on a share-cropping basis. The Indians were to pay for these materials with half their harvest. This idea was presented at a meeting of the mayorales, who are the Indian leaders of the community and foremen for the patron. Fearing for their privileged position, the mayorales were disinterested in the offer. Realizing this, the scientists went to the community at large and presented their idea at the mando, the weekly meeting for assignment of work. The general reaction was one of suspicion. A few very poor Indians elected to participate in the program, but their motive was desperation. Their families were so close to starvation that they were forced to accept any opportunity to raise their standard of living. The majority of the men drew back. They had become wary

(Right) The new school at Hacienda Vicos, with about 250 pupils. Pupils are shown leaving the school for recess.

(Below) The old school building at Hacienda Vicos. It had 15 pupils at the time it was replaced by the new school.

Indians plowing hillside field for the planting of barley. Plow is of ancient Egyptian type, has only pointed sticks (no metal) for tip.

when one of the mayorales spoke up against the program and their traditional prejudices led them to suspect the intentions of the new patron. Since they assumed that the scientists had merely devised a new way to cheat them, they pitied the Indians who had chosen to participate.

The program proceeded. The scientists distributed blight-resistant potato seed among the few participants, who were given instructions carried out to the letter. They were required to plant the seed at eighteen-inch intervals, rows three feet apart. They were shown how to disinfect the seed potatoes and the land in order to guard against blight. The scientists passed out fertilizer and insecticide, and taught the Indians how to set up an effective irrigation system. They demonstrated modern techniques of cultivation and introduced every possible means of jacking up the productivity of the land.

The results were gratifying, for the harvest was twice what it had been in previous years. When the participants were given half their crop, Indians were astounded that the new patron had not exploited them. The following year presented new participants anxious to share in the success of modern cultivation methods. By 1955 the scientists were able to abandon the share-cropping arrangement in favor of a credit system, because the Indians consistently paid their debts at harvest time.

Education Program

Another problem pleading for attention was the educational deficiency. Only two per cent of the people were literate. School on the hacienda consisted of one class. Eight children of assorted ages met on an open porch where a woman attempted to teach them reading, writing, and arithmetic. Classes were conducted in Spanish, a struggle for most prospective students who knew only the Indian language, Quechua. Attendance was irregular. Peruvian law requires that one child from each family attend school, but on the hacienda it was frequently a different child each day from the same family. The reason is that in the struggle for bare existence, the Indians could not see how education would serve to any advantage. They regarded attendance at school as merely another service owed the patron.

The first step in the program for education was to construct a new school building. This was discussed with the Indians at a meeting. They agreed to provide the labor, while the Project would supply funds and materials. In 1952 ground for the new building was broken. The Indians quarried stone for the foundation, baked clay bricks for the walls, and hewed door and window frames from eucalyptus wood. The Project had to finance and import only glass and cement. They also had to bring in mestizo craftsmen, since the Indians simply did not possess the skills of modern construction.

The finished product is a handsome school building. The layout includes classrooms, an auditorium, a dining room, a kitchen equipped for hot meals, and living quarters for teachers. To go with the new school, the curriculum was revamped. Vocational instruction is offered to the boys, who are particularly interested in agriculture and carpentry. The girls continue to receive a primary education. There are now eight teachers, while the original handful of students has expanded to two hundred of the Viscosino youth. The educational program has given the Indians pride in their community for theirs is the finest rural school

in the area, and they have won the respect of their neighbors.

A health program was a necessary ingredient in the Project. The disease-ridden people knew only religious and magical means of treating their ailments. The program provided a clinic, set up by the public health agency of the Peruvian government. A doctor and two nurses come to the hacienda twice a week. Supported by the United Nations International Children's Emergency Fund, the program concentrates on school children and maternal welfare. Medical service is available to everyone, since the doctor is prepared to treat all cases, dispensing medicine and advice.

General view of the "plaza" in Hacienda Vicos. Storehouses in foreground of old type construction; part of new school in left background. Under construction (right background) are living quarters for school teachers.

Social Changes

Technological advances centered around the agriculture, education, and health programs. Accompanying social changes were necessary if the people were to profit as much as possible from the material improvements. When the Project arrived at Hacienda Vicos, the social system was as primitive as the technology. The peonage system operated intact as it had for centuries, and the Indians were mere serfs, impoverished and irresponsible. Each family had to send one adult member to work on hacienda land three days each week without pay. In addition, free services for the patron's household were required. In return the family received a few acres to farm and were allowed use of the stream and pastureland. The patron exploited the Indians whenever he could, and tradition bound him to do little else.

The Viscosinos were further exploited in relations with the outside world. Neighboring mestizos, who possessed a higher standard of living, found it to their advantage to keep them suppressed. The Indians were frequently hired out by the patron to labor in other communities.

The scientists wanted to revise this social structure. It would prove to be a revealing experiment, for if they could develop a sense of responsibility among the people, they would leave behind them a community able to conduct its own affairs effectively.

To give the Indians responsibility, the scientists invited them to participate in decision-making. One opportunity was the weekly mando. At these meetings the Indians were allowed to air their complaints, and their ideas were used whenever possible. The scientists used the mando to study the general response to ideas and changes which they had introduced. They also used this chance to publicize the progress of the Project and win support.

The Indians had never been expected to say a word about economic and political affairs on the hacienda. They had depended on the patron whenever any decisions were to be made. The Project gave them their first chance to express their ideas and govern themselves. They cooperated with the new patron in running the hacienda, and together worked out very successful agricultural and educational programs.

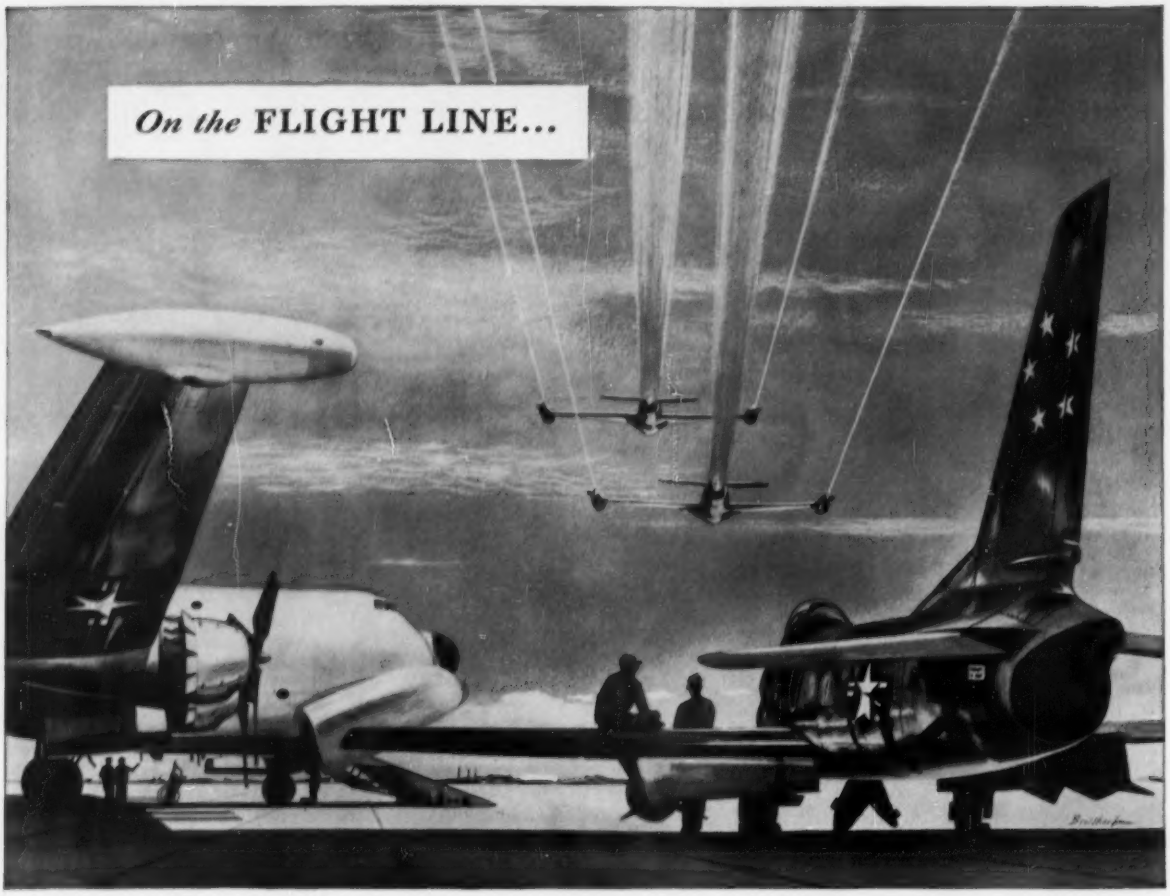
Other social changes followed. Positions of responsibility on the hacienda had been held formerly by employees hired from outside communities. The Indians felt hostile toward these outsiders, and the scientists found it advisable to replace them with promising Viscosinos.

Free services to the hacienda were abolished. The Indians were no longer required to work as cooks, shepherds, and domestic help without remuneration. They were hired and paid.

Exploitation was brought to an end. Returns from Indian labor were no longer channeled into profit for the patron, but plowed back into the Indian community. An example is the new school building.

These were steps calculated to give the Indians a new lease on life. They were no more than small changes in the traditional social framework, but their effect is apparent in the few years since the Project came to Hacienda Vicos. The Indians feel pride in their community and are working together to improve it. They are allowed dignity, which is novel after centuries of degradation. Given responsibility, they are learning how to conduct their lives and their community.

The Cornell-Peru Project came upon a picture of hopeless poverty on Hacienda Vicos. In order to raise the standard of living, the Project introduced technological advances into agriculture, education, and health. In order to develop a sense of responsibility and community pride, the Project organized institutions which would enable the Indians to direct their affairs when the Project had withdrawn. Today the results along these lines have been gratifying to anyone interested in making backward areas a part of the modern world.



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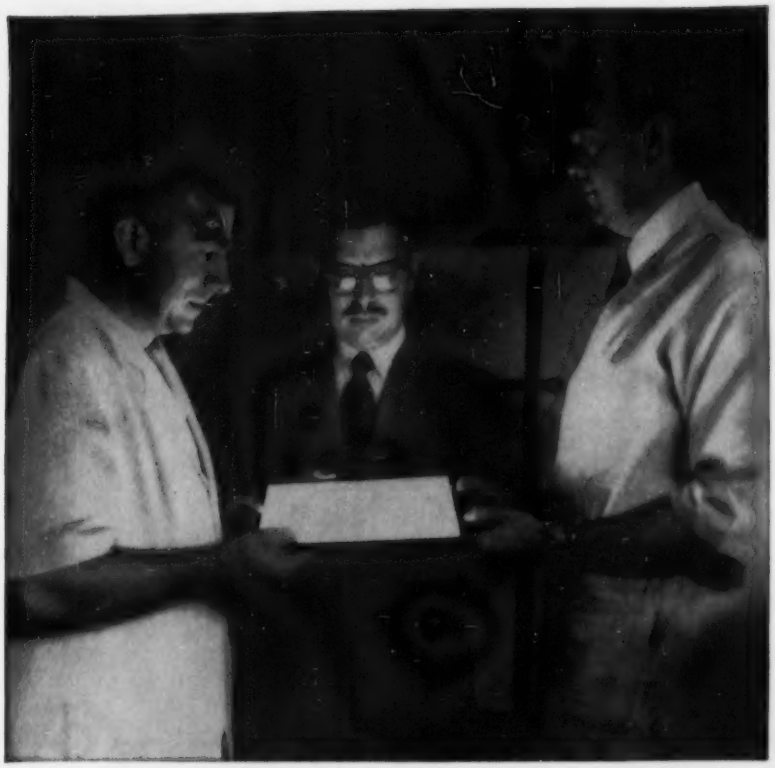


"Glowing wafer" of light (electroluminescence) sheds illumination on the faces of three Westinghouse scientists who helped to develop it. Left to right: Dr. Willi Lehmann (University of Brunswick, Germany); Dr. Henry F. Ivey (University of Georgia, Massachusetts Institute of Technology); and R. W. Wollentin (Rutgers University).

The Light With no Third Dimension

A new source of light is nearing practicality. Called electroluminescence, it comes from a flat surface. By the twist of a knob, you can change the brightness, or even the color, of a room.

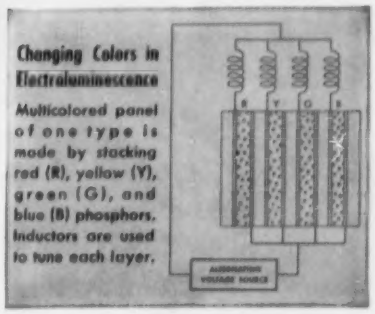
Since electric lighting first became practical, only three basically different light sources have achieved widespread use—incandescent, fluorescent, and gas-discharge lamps. Now a fourth basic type—electroluminescence—is nearing practicality. With fewer theoretical limitations than any of its predecessors, it promises to revolutionize lighting and become a practical light source of the future.

In an incandescent lamp, light comes from a single point. In a fluorescent lamp (form of gas-discharge), light comes from a straight line. In electroluminescence, light comes from an area or flat surface. Electroluminescence is light emission from phosphor powders embedded in an insulator, excited by an a-c field.

Westinghouse engineers gave the first practical demonstration of this new light source. They lighted an entire room with flat electroluminescent panels on the ceiling and three walls. These panels were one-foot-square flat glass plates about as thick as a window pane and coated with a plastic containing the phosphor. They were topped off by an aluminum conducting coating. Hooked up to a source of power, these plates had a brightness of 100 foot lamberts in their present stage of development.

Since some phosphors have more than one emission band, the color and brightness of electroluminescent lighting can be changed by varying the frequency. It is possible to control the color of a room, and brightness too, simply by twisting a knob. Besides supplying ordinary light, this new light source has other fascinating possibilities. Just one is "picture framing" television. An electroluminescent cell might replace the conventional cathode-ray tube in such a set.

Westinghouse engineers, under the supervision of E. G. F. Arnott (Princeton '28), developed electroluminescent lighting under the name of "Rayescent" lighting. Westinghouse approached the problem, not as a commercial venture, but as a pure research project. Much work remains to be done in this field. It is typical of the pioneering developments undertaken by Westinghouse.



Changing Colors in Electroluminescence

Multicolored panel of one type is made by stacking red (R), yellow (Y), green (G), and blue (B) phosphors. Inductors are used to tune each layer.

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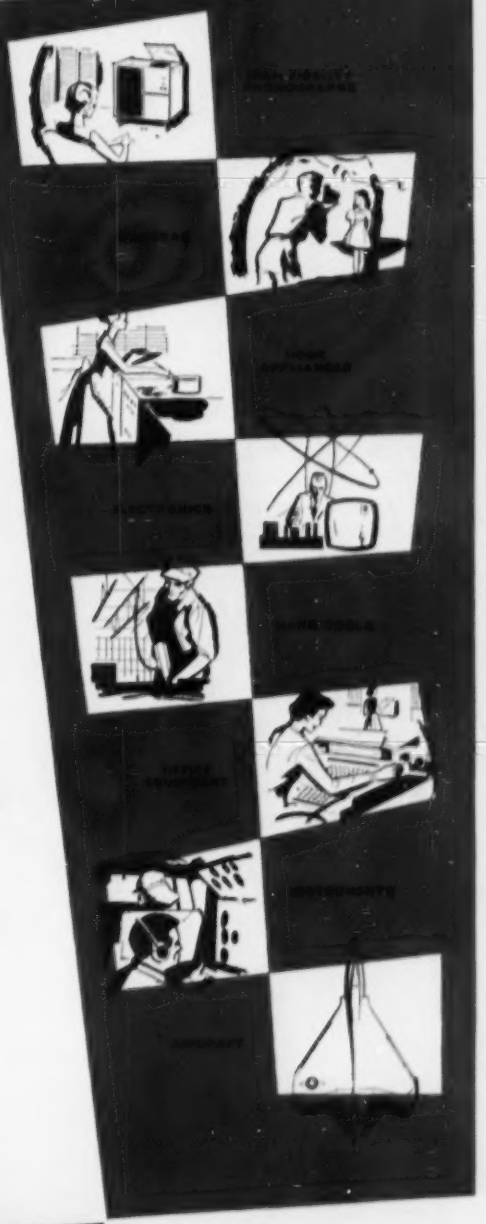

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MAXWELL UPSON: OUTSTANDING ALUMNUS

by

Richard Brandenburg, ME '58

Maxwell Upson

"The secret of success is getting along with your fellowmen." Maxwell Upson has put his conviction into practice in a colorful and significant career as engineer and corporation executive. A graduate of Cornell University as a mechanical engineer in 1899, Mr. Upson is today Chairman of the Board of the Raymond Concrete Pile Company. Although he is over eighty, he still develops pioneering ideas in the field of construction engineering. Mr. Upson has translated his success into opportunities for young people to study engineering by donating the funds for Cornell's new mechanical engineering building, Upson Hall.

Mr. Upson believes that extracurricular activities are important in cultivating a sense of understanding and teamwork with others. He states "When I was at Cornell, I had an average of about 78. But I had a good time doing many things that I now believe were worthwhile." As an undergraduate, Mr. Upson was Business Manager of the Sibley Journal, predecessor of the CORNELL ENGINEER. In addition, he was president of his class during his senior year, and a member of Aleph Samach and Sphinx Head honoraries. His continuing loyalty to Cornell is shown not only in his gift of a new building, but also by his continuous service since 1925 on the University Board of Trustees.

According to Mr. Upson, the five year course reflects the biggest change in engineering education since his undergraduate days. He believes that "English is the most important liberal subject for engineering students. Public speaking, clear thinking and letter composition are all-important. You can't get along without them if you are going to be a leader in science and industry." He also feels that fluency in foreign languages will be increasingly helpful to engineers as business operations become international in scope.

Mr. Upson believes that a good engineering course gives students basic principles, enabling them to pursue specific fields after they graduate. He states "In college we get a road map telling us where to find information." He still studies three or four nights a week in pursuit of answers to ever-developing business and technical problems. This study has enabled him to pioneer in the use of concrete—both reinforced and prestressed—in all phases of construction: foundations, marine pilings, offshore oil derricks, bridges and piers. He has also initiated the process of prestressing.

The son of a North Dakota wheat farmer, Mr. Upson first learned about machinery during his farm life. At seventeen, he was the youngest licensed steam boiler engineer in North Dakota. He gained his first experience in leading men as supervisor of harvesting and threshing crews. After graduation he became a construction superintendent for Westinghouse, Church & Kerr. In this organization of engi-

Upson Hall during an early stage of its construction. North Face.

neers and contractors, he specialized in industrial plant and powerhouse design and construction. In 1905 he joined the Hockanum Mills Co. of Rockville, Conn. As chief engineer and assistant to the President, he designed the first textile mill made entirely of reinforced concrete. In 1907 he began his career with the Raymond Concrete Pile Company.

To overcome the prejudice against concrete pile construction, Raymond needed a man with Upson's technical training and experience. Upson, in turn, was convinced that the concrete pile would play a major role in the construction industry. So he acquired a substantial interest in the Raymond Concrete Pile Company, was elected a Director in September 1907 and made Secretary-General Manager-Chief Engineer. In 1917 he became Vice President. In 1930 he became President, and since 1946 has served as Chairman of the Board.

Under Mr. Upson's leadership, Raymond eliminated the debt which had hindered its growth before Upson joined the organization, and declared its first dividend in 1915.

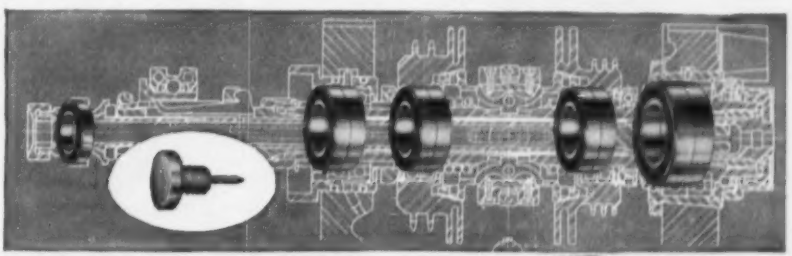
Building on a foundation of fairness and honesty in business, Mr. Upson and his associates have made Raymond one of the large international construction firms of the world. Its thirty-five offices are located throughout the United States and foreign countries. Raymond has completed foreign construction projects valued at more than $1,400,000,000. Mr. Upson himself has traveled extensively in Europe, the Orient, and South America in connection with foreign projects.

Characterized by Time Magazine as a man who gives off engineering ideas "like sparks from a busy grindstone," Mr. Upson is still considered the idea man of the Raymond Company. While with Westinghouse, Church & Kerr he invented and patented an automatic gas producer. The money from the sale of the rights of this invention enabled Mr. Upson to purchase an interest in the Raymond Concrete Pile Company. Today he continues to devise new applications and equipment for concrete construction.

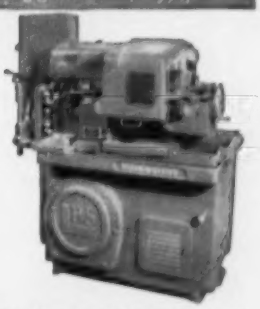
Mr. Upson has witnessed many changes since his graduation from Cornell nearly sixty years ago. In 1899 the total engineering undergraduate enrollment was 686. In 1956, 650 freshmen were admitted to the College of Engineering alone. Although business, like the University, has become larger and more complex, Mr. Upson believes today that corporations must be led by men of spiritual strength, who are completely honorable in thought and action. He believes there are times when they must find spiritual guidance to help them overcome internal friction in their organization, counteract individual aspirations and jealousies, and determine what is fair for labor, stockholders, government and public. To Mr. Upson, his success hinges upon the teachings of Christ and the spirit of the Golden Rule as keys to cooperation and teamwork with his fellow men. He asserts that many of his acquaintances who are themselves leaders of big corporations are men of deep religious convictions.

Maxwell Upson was guest speaker at the banquet of the Cornell chapter of Pi Tau Sigma, after his initiation as an honorary member of the national mechanical engineering honorary last May. He told his audience that success is not measured in terms of money. He said that engineering students at Cornell must gain the invaluable qualities of hard work and the ability to get along with others. Mr. Upson concluded that ideals and faith have the most to do with real success. He said "Faith helps you through tough situations . . . . . and ideals hold us to our course—we need to get ideals in our minds, and then into industry."

Maxwell Upson's words were more than just good advice. Faith and ideals, combined with hard work and consideration for others, are the realities that mark his entire career. His life as well as the new building that bears his name make Mr. Upson an outstanding alumnus who will significantly mold the careers of future Cornell engineering students.



7 Seconds From Nothing Flat!



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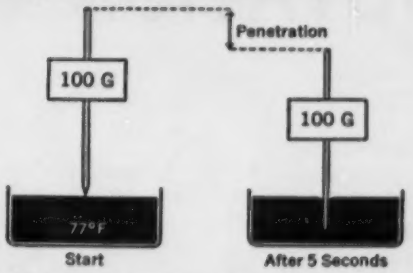
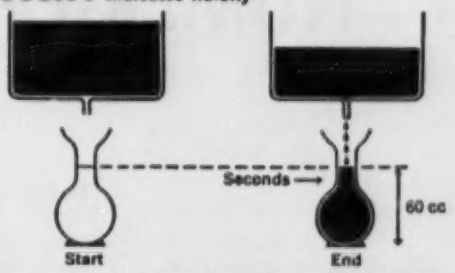


Consistency is determined by measuring the **penetration** made in 5 seconds by a standard needle loaded with 100 grams. The test is normally run at 77°F and penetration is measured in units of 0.1 mm.

FIG. 1

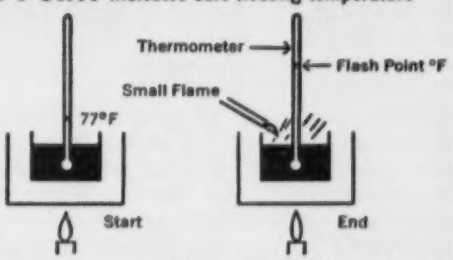
VISCOSITY indicates fluidity



Fluidity is determined at specified temperatures with a Saybolt-Furol Viscosimeter. Results are expressed as Saybolt-Furol Viscosity . . . the time in seconds for 60 cc of the product to flow into measuring flask through a precisely dimensioned orifice. The slower the flow, the higher the viscosity.

FIG. 2

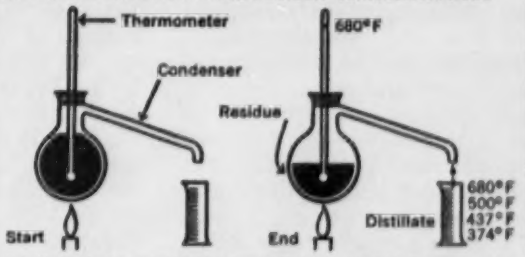
FLASH POINT indicates safe heating temperature



Volatile constituents evolve when the temperature of an Asphaltic product rises sufficiently. The temperature at which they "flash" or temporarily ignite when a small flame is passed through them, during heating of the product, is its **flash point.** This temperature is usually well below the **fire point** or the temperature which will support burning.

FIG. 3

DISTILLATION indicates volatile content...residue



Volatile Content is determined by gradually heating to 680°F, a measured volume of material in a distillation flask connected to a condenser. Relative amounts of volatile materials evaporating at different temperatures and of residual Asphalt are thus determined. Further tests are usually run on Asphalt residue to determine its characteristics.

FIG. 4

Tests on Asphaltic Materials

The suitability of an Asphaltic material for highway or other use depends upon characteristics which can be determined by a series of tests. Four of the principal tests are:

PENETRATION TEST (Fig. 1)
indicates the *consistency* or hardness of Asphalt cements (which are semi-solids) used in hot-mix Asphalt pavements. The softer the product, the greater its number of penetration units. On the basis of consistency . . . denoted by penetration ranges . . . Asphalt cements are classified into grades. Those paving grades now recommended by The Asphalt Institute are:

PENETRATION GRADES

60-70 85-100 120-150 200-300

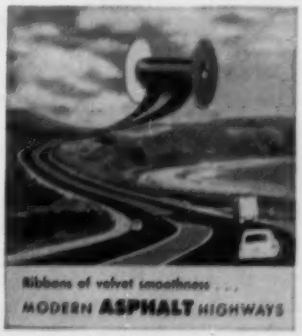
(a 40-50 penetration grade is recommended for special and industrial uses.)

VISCOSITY TEST (Fig. 2)
indicates the fluidity of liquid Asphalts. Viscosity measures the consistency of these products just as the penetration test measures the consistency of semi-solid products. Those liquids flowing too slowly for accurate measurements by the viscosimeter at 77°F are tested at higher temperatures—usually at 122°F, 140°F, or 180°F.

FLASH POINT (Fig. 3)
indicates the temperature at which vapor ignition may occur when heating and manipulating Asphaltic materials.

DISTILLATION TEST (Fig. 4)
indicates the amount of Asphaltic residue to expect in liquid Asphalts after lighter constituents volatilize under manipulation and use. It indicates, too, the relative rapidity at which these lighter constituents "cure" out of the Asphalt.

Be sure to cut out and file this data sheet, as well as future sheets and those previously inserted in this publication. Make them your professional reference material.



THE ASPHALT INSTITUTE, Asphalt Institute Building, College Park, Maryland

THE DEVELOPMENT OF NUMERICAL NOTATION

by

Peter H. Jedel, EE '61

The concept of numbers is not a difficult one for us to grasp. Primitive man, however, struggled for many ages trying to understand it. For a long time the concept eluded him, and he referred to objects as one and many. However, as he developed in intelligence he began to perceive the difference between small groups. His mind was still not able to distinguish between a group of four or a group of five. An interesting note is that even today we can not perceive at a single glance a group larger than five without breaking the group up into smaller segments. Try it.

A. & & & &
B. @ @ @
C. • • • • • •
D. # # # # #
E. % % % % % %

As you can see it is easy to recognize groups A and B and perhaps D but C and E are very hard to perceive at a single glance.

The Need for Numbers

The ideas of numerical notation gradually developed as the need arose. It was the nomadic farmers that first developed the notion of counting as they had to keep track of the amount of cattle they owned. At first the farmer merely counted on his fingers and toes and those of his neighbors. This proved sufficient for the farmers but not for the merchants. They had to develop some method for keeping track of the money they collected.

Earliest numerals that we have records of consisted merely of simple marks for all numbers below ten with a special symbol for ten. The first records we have appeared in Egypt around 3400 B.C. and in Mesopotamia around 3000 B.C. There seems to be two distinct methods of notation that were developed. The first consisted of making vertical marks for the numbers one, two, three and the other simple numbers. This is similar to our present one (1). The other system consisted of making horizontal lines for the simple numbers one, two, three, etc. It is believed that a corruption of these symbols has become our current two and three.

Greek Numerals

The Greeks main contribution was their grouping of numbers in accordance with powers of ten. They had a symbol for 10; 100; 1000; 10,000; and 100,000. They used the first letter of the word for their symbols.

Units	Α 1	Β 2	Γ 3	Δ 4	Ε 5	[F] 6	Ζ 7	Η 8	Θ 9
Tens	Ι 10	Κ 20	Λ 30	Μ 40	Ν 50	Ξ 60	Ο 70	Π 80	[Q] 90
Hundreds	Ρ 100	Σ 200	Τ 300	Υ 400	Φ 500	Χ 600	Ψ 700	Ω 800	[&] 900

This system was an important forerunner of our present decimal system.

Roman Numerals

It was because of the profound effect of the Roman civilization upon the rest of the world and the obvious simplicity of the Roman number system that it was of extreme importance for nearly 2,000 years. Its chief benefit was that for the mass of its users, the memorizing of only four letters was necessary; V, X, L, and C. People found it easier to see three in "III" than in "3". Another important benefit was that all of the numbers were formed by simple addition or subtraction to the basic forms. Thus nine was formed by subtracting one from ten i.e. IX.

Many claims have been made as to the derivation of our own numerals. The chief claims seem to be that our numbers stem from the Hindu-Arabic number systems. The country, however, which first used the largest amount of the numerals that we do was, to the best of our knowledge, India. The 1,2,3,4,5,6,7 and 9 have all been found in forms that have considerable resemblance to our own. None of these early records give any evidence of the place-value system or of the zero which makes it possible. The actual development of the zero is not known but the first evidence of its use was in an astronomical table found in Arabia about the ninth century A.D.

Number Systems

In the history of numbers, there have been many different systems in use. The *pair system* has numerals for one and two and forms additional numbers by addition to the pair.

Eg. 3=2+1, 4=2+2, 5=2+2+1

This system is most evident in the very backward people. Evidences of this system have been found in Australia among the Kulin-Kuraai of the south-east and the Narrinyeri of the south; several of them count up to ten in this manner. The pair system starts with an association with parts of the body that exist in pairs, the eyes, ears, arms and legs.

The *Quaternary System* forms the numerals above four by the addition four of lesser numbers.

Eg. 7=3+4, 8=4+4, 9=4+4+1

In California it has been found with the Salina. The reasons for its development have been due to the religious significance of the four quarters of the sky in the religion of the Salina.

The *Quinary System* is very rare. It is found in a pure state where ten equals two hands, twenty-five equals five hands, etc. In fact as a pure state this system is found only in a South American tribe usage.

The pure *decimal system* seems to have originated in the culture cycle of the nomadic herders, who, in counting their flocks of horses, cows, etc. needed to employ large numbers with facility. From this beginning this number system has spread to the entire world.

This form of number system is based on the number 10. We utilize nine numbers and then repeat the first with a zero, 10. If we were to read what the various numbers represented it would be as follows: 24 read as two times ten to the first power plus four times ten to the zero power; likewise 163 would be read as one times ten to the second power plus six times ten to the first power plus three times ten to the zero power. In other words, the position of the digit is merely a shorthand way of representing a power of ten that is understood to the reader. The columns from right to left (increasing value) are called the unit column, ten column, hundred column, thousand column, the ten thousand column and so forth constantly increasing by powers of ten. The basic fault in the decimal system is the relatively few divisors ten has. In fact, only two and five divide evenly into ten. Much confusion arises due to the fact that our number system which is based on ten is called a decimal system as is the system of decimal fractions prefixed by the decimal point. This leads people to believe that only with a base of ten can we have decimal fractions, that is the use of the decimal point for these fractions. This is to a large degree untrue. In fact the choice of ten as a base of a fraction system is a very unwise choice. This is because of its few factors and the resulting repeating decimals. A fraction like ⅓ is represented by .333333. . . . . without any end. It is for this reason and for other simplifications that are apparent at first glance that I would like to propose the adoption of a new number base. I would propose a number system based on 12, a DUODECIMAL SYSTEM.

Duodecimal System

There are many advantages for the adoption of this base. One of the more easily seen advantages is the number of factors that divide twelve evenly. There are 2,3,4, and 6, or twice the number of factors of ten. Problems involving feet and inches would be simplified and the number of repeating fractions would be reduced.

The idea of a duodecimal system is not a new idea. Isaac Pitman, the inventor of Pitman Shorthand, was an early proponent of duodecimal as was Herbert Spencer, British philosopher. In our own country there is a Duodecimal Society that was organized in 1944 and puts out a regular bulletin to publicize the duodecimal system. The most important concept when dealing with the duodecimal system is to think in terms of dozens rather than tens. That is the number 11 in the duodecimal system would be thought of as one dozen and one or in our decimal system as 13.

Decimal vs. Duodecimal

1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	X
11	E
12	10
13	11
14	12
100	84
120	XO
144	100
1728	1000
20,736	10000

To change from the decimal system to the duodecimal system it is necessary either to make successive divisions by 12 or to think in terms of dozens. I prefer the latter method.

That way the decimal number 41 would first be thought of as having 3 dozen and 5 units and then it would be written as 35. Other conversions would be 66–56; 92–78; and 108–90. The next thing one must consider if he wishes to develop a knowledge of the duodecimal system is the naming of the various columns of figures. The units column is still called the units column; however, when we get to the next column, the differences begin. The second column is called the dozen column and is followed by the grand, dozen grand and the gross grand columns.

All the rules of arithmetic apply to duodecimal notation except instead of thinking in terms of tens we must think in terms of dozens.

Addition	*Subtraction*
39641	
72386	3E
5X42X	−18
20961	—
32E02	23
1X1X98	

The last important advantage of the duodecimal system of notation is its ability to multiply feet and inches by feet and inches directly without having to convert them into either feet or inches. This can be very time saving when repeated steps of multiplication are involved.

$$\begin{array}{r} 3'\ 4'' \\ \times\ 4'\ 6'' \\ \hline 1'\ 8''\ \ 0'' \\ 13'\ 4'' \\ \hline 15' \end{array}$$

Thus it is seen that the use of the duodecimal system makes easier a lot of present problems. It is for these reasons that I say it is worth the effort to learn the two new symbols and the new way of thinking as the actual savings in the future will make up for any trouble in learning.

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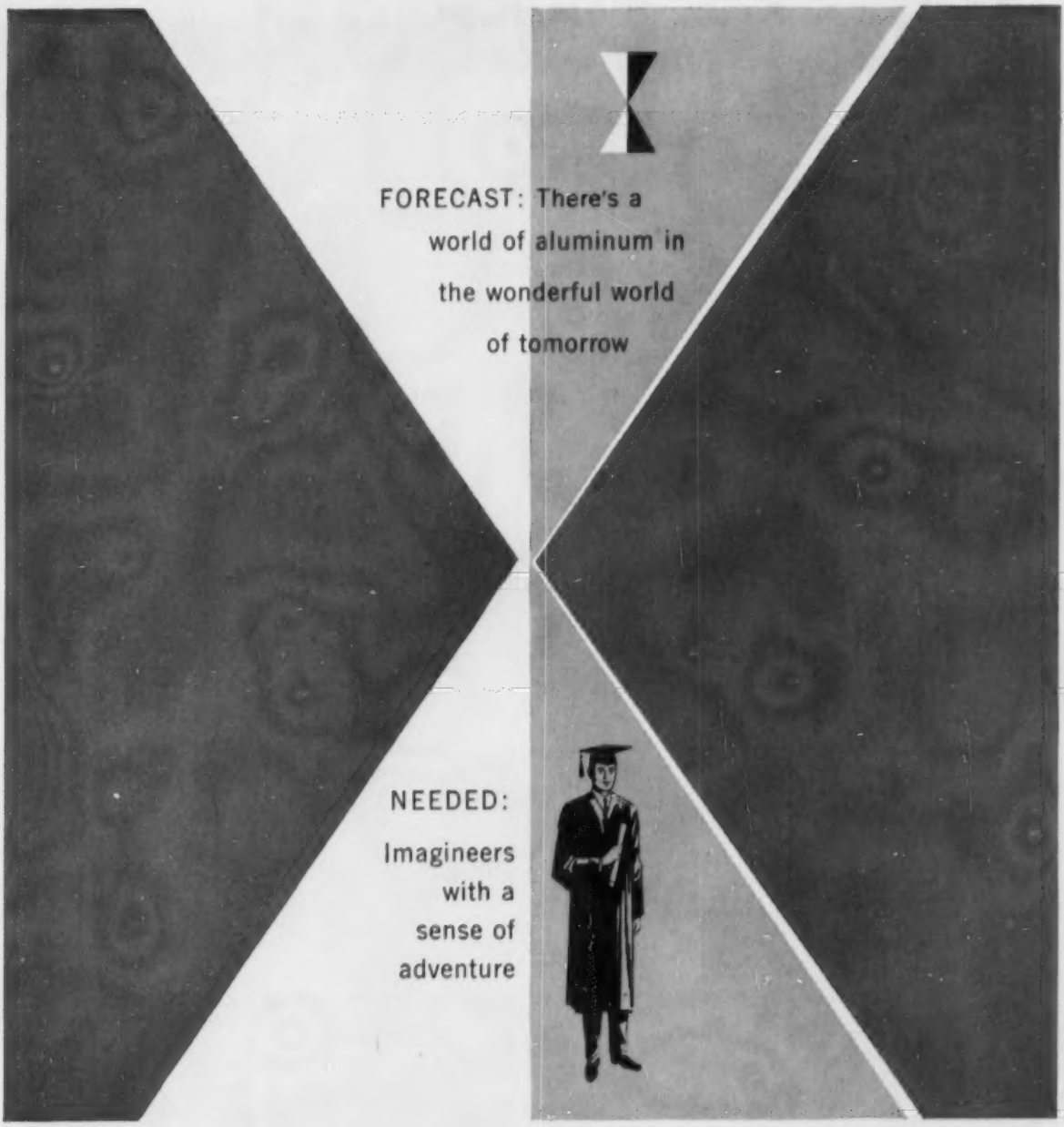

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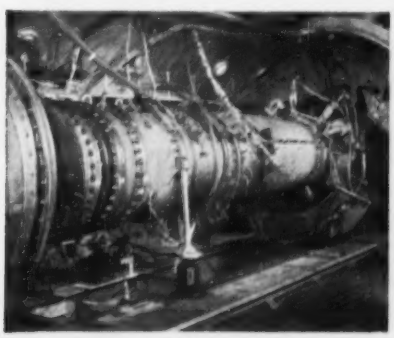
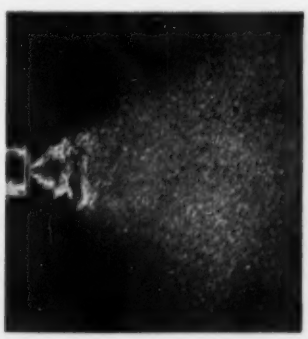
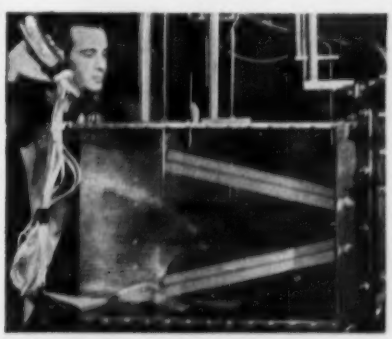
While combustion assignments, themselves, involve a diversity of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program—with other far-reaching activities in the fields of instrumentation, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's engineering students.



Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.



Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

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In order to do what must be done, to gain some recognition in extra activities, and to have time for recreation, you will find it necessary to budget your time with care. It is one more difficult problem to face, but it is very definitely a part of the job. That it can be done is evidenced by the record of participation by engineers in major sports, in publications and in all of the other activities on the campus. The ability to plan one's expenditure of time is one of the important secrets of success, in after life as well as in college.

Another secret (a secret only because so few seem to learn it) can be described simply as diligence. The line between mediocrity and outstanding performance is astonishingly thin and the extra effort required to push one over the line from average to superior grades is less than you would think. An extra half-hour on the books, a determination to "get this thing if it takes all winter," a refusal to give up when the answer just won't come, will do it. The habit of determination is beyond price.

These abilities, you will find, are common to those who have gained recognition in their chosen profession, and they are of greater value than genius. We who have gone before pass them on to you that you may benefit.

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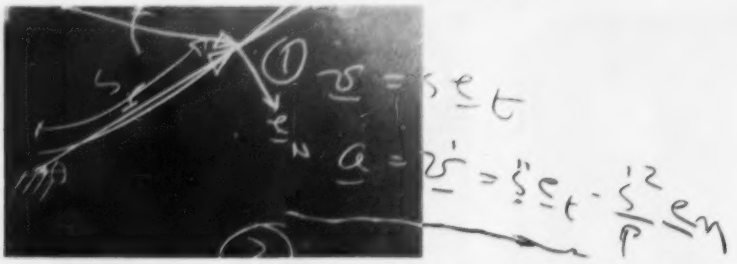
A WELCOME



TO FRESHMAN ENGINEERS

FROM THE DEAN:

It is a pleasure to welcome you to Cornell as members of the Freshman Class in Engineering.

I am sure you have come to realize that you are entering now the most important period of your preparation for a lifetime career. The direction and shape of your future very likely will be determined to a considerable extent in your next five years at Cornell—five years which constitute the most productive investment you can make for a successful career. I cannot urge you too strongly to keep in mind that in this time you must establish a foundation upon which you can build a professional life for thirty, forty, or fifty years.

The engineering curricula at Cornell provide a superior educational preparation, second to none. They are designed to train for professional leadership, and as such they are demanding of our best mutual efforts. I can assure you that we are determined to work with you in every way possible to bring about the most effective kind of educational experience.

It would be unrealistic, however, to expect that the path will be smooth and troublefree for all. It is likely to be the most challenging you have ever attempted, but by the same token, also the most rewarding. For some the adjustment of these first few weeks may be difficult and perhaps even momentarily discouraging, but I want you to know that we stand squarely behind you, asking in return your own sincerity of purpose. You have been chosen for the engineering program at Cornell on the basis of a highly selective admissions procedure. We think you can become a Cornell Engineer, and our every effort is directed toward having you take your place in this distinguished family.

Dean S. C. Hollister

In urging you to your maximum effort I do not intend to sound an unnecessarily stern note. This is a joyous occasion and the beginning of one of the most happy and fruitful periods in your life. The opportunities for your personal development will be almost limitless. Cornell is a spiritual as well as an intellectual experience and I hope that you will take full measure of all that is here for you.

You are part of the almost minute percentage of young people your age who are in this most fortunate situation. I congratulate you on the opportunity that is before you. The College will watch your progress with warm interest and will assist you in every way to achieve your goals.

S. C. Hollister, Dean
College of Engineering

The modern lounge in Sibley Hall.

OPPORTUNITY FOR FRESHMEN:

THE CORNELL ENGINEER

THE CORNELL ENGINEER hopes many freshmen will visit our new offices in Carpenter Hall for the fall competition. As the name implies, THE CORNELL ENGINEER is a magazine that is published by our engineers and concerned with the many aspects of their field. We do our best to keep abreast of the new scientific discoveries both on and off the campus and to present the undergraduates, the faculty, and the alumni with the news in as stimulating a fashion as possible. This goal requires the joint efforts of many people, and the combination of their individual talents is the power behind our monthly effort.

If you enjoy writing, in addition to seeing your name bylining an interview or technical article, most likely the Editorial Board will capture your interest. These members write copy, edit articles, compose headlines, and organize material for future issues. Since news is being made on the Cornell Campus every moment, it is up to members of the Board to see that it is printed and presented. Undergraduates, graduate students, faculty members, and the administration are all potential sources of information. The Board member knows what is happening and where. Discoveries outside the vicinity of Cornell are also at his fingertips since the "ENGINEER" office is a clearing house for the reams of copy that are sent to be published by other universities, companies, and research agencies. We have a complete orientation program designed to familiarize even the novice with all phases of the publishing business; so that interest, a basic knowledge of English, and a desire to write are the only prerequisites for competing. The rest is to be revealed through the competition itself.

Those who favor drawing or photography will want to direct their interests to the Illustrations Board. Photographers have the use of a Crown Graphic and other professional equipment to cover assignments on campus. Cartoonists and freehand artists sketch drawings that are published with staff articles. Diagrams and schematic layouts, used to supplement photographs, are drawn by draftsmen. Once the techniques of photography and drawing are mastered, the Illustrations Board member goes on to employ the principles of good design in planning the layout of the magazine. His ideas provide the lift and color that make the ENGINEER enjoyable reading.

If you are more interested in management, sales and promoting however, the Business Board offers you ample opportunity. The Business Board member forms the solid core of the ENGINEER'S operation. He holds the money and controls all the financial transactions. It is up to him to know where the money comes from, where it goes, and how much we can afford to spend on special projects such as trips and parties. Advertising, a large part of the ENGINEER'S revenue, must be carefully supervised by the Board member. Once the magazine is printed it must be distributed, and here again the Board member takes charge. It is the circulation department that handles subscriptions, plates, mailing, billing and distribution of the magazine on the campus and around the country.

The Board members write articles for the Cornell Sun in addition to commercials for the University radio station, WVBR.

Publishing a magazine isn't easy. Sometimes the work is demanding and arduous. Every month the tempo increases as writers and editors hustle to meet deadlines. But we feel that it is worth it. We take pride in, and derive personal satisfaction from our efforts. Perhaps you will too. If the Editorial, Illustrations or Business Boards seem interesting, come to our October eighth meeting at Carpenter Hall.

Two engineering students try to work out some details of a forthcoming *Engineer*.

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	  ◦ Pulse Circuits
	• Digital Computers and Data Processing
		• Gyro Development
		• Servo-mechanisms and Feedback Systems
		• Analog Computers
		• Military Specifications
		• Electronic Circuitry
		• Magnetic and Transistor Amplifiers
		• Network Design
		• Inverters
		• AC and DC Servo Motors
		• Electronic Research
		• Missile Control Systems

MECHANICAL ENGINEERS with 2 or more years experience in:	• Inertial Guidance Systems • Gyro Development • Military Specifications • Servo-mechanisms • Product Design and Packaging of Electro-Mechanical Devices • Fire Control Systems	• Inertial Guidance Systems • Gyro Development • Military Specifications • Servo-mechanisms • Product Design and Packaging of Electro-Mechanical Devices
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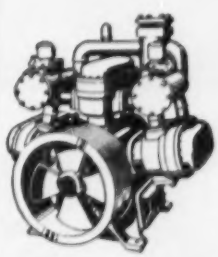

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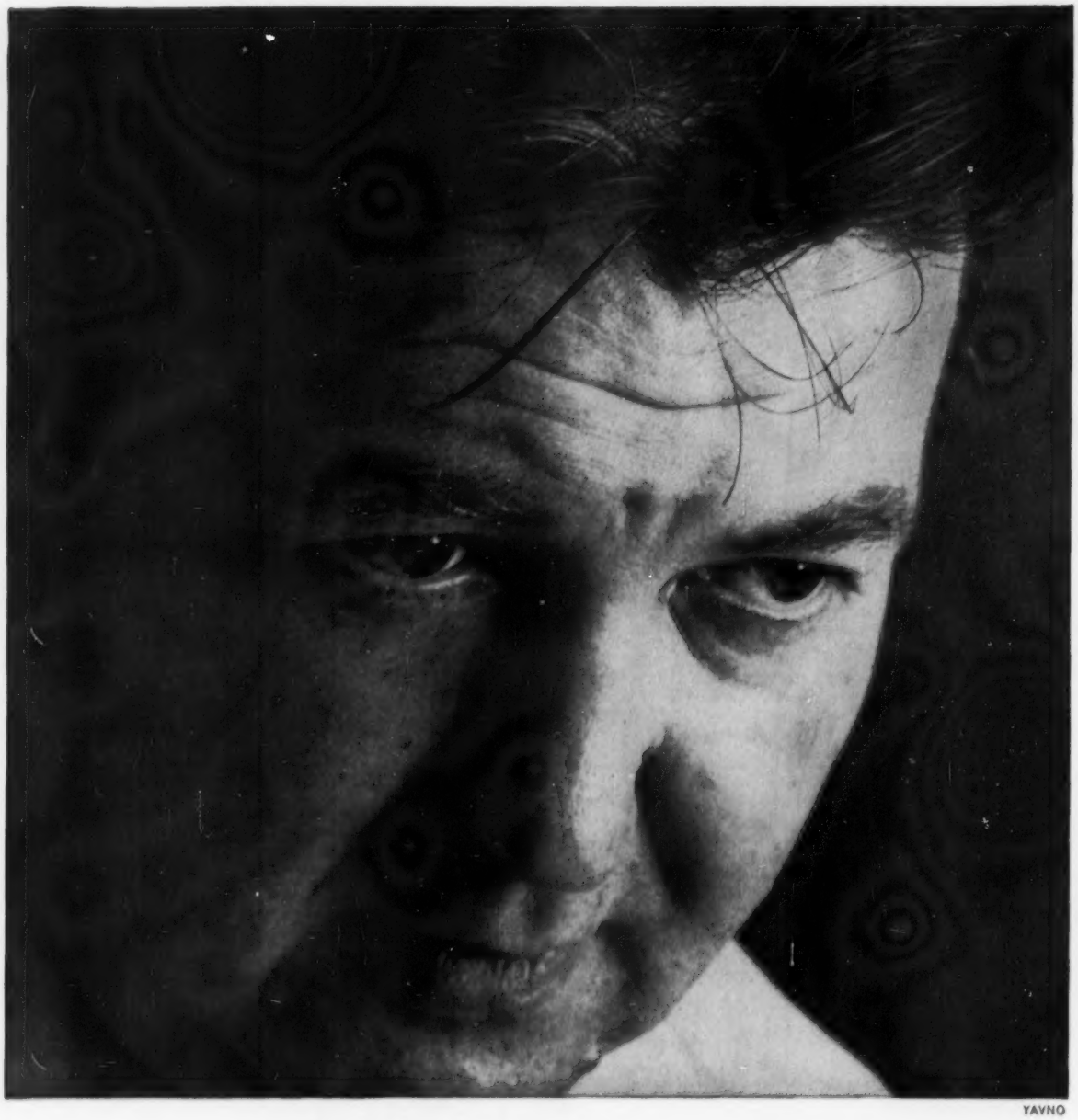

YAVNO

...on the second language

"Our first language is English. Our second is Mathematics. Not all of us are truly bilingual, but probably all are versed in a few concepts of Mathematics — that of a function, for example. The majority of us know those fields of mathematical analysis which developed with the physical sciences well enough to use them as the principal tools of our professions. A minority of us — the professional mathematicians — have pushed on to ground which may never become a public park, but parts of which are clearly exciting. Some strive to master electronic computers which already compress thousands of arithmetical operations into a second. Others, with the sharpest tools of modern Mathematics, carve out fields for use where human elements and decisions are paramount, and for use on problems which could be solved by enumeration, if life were long enough — life of the Universe, that is."

—J. D. Williams, Head of the Mathematics Division

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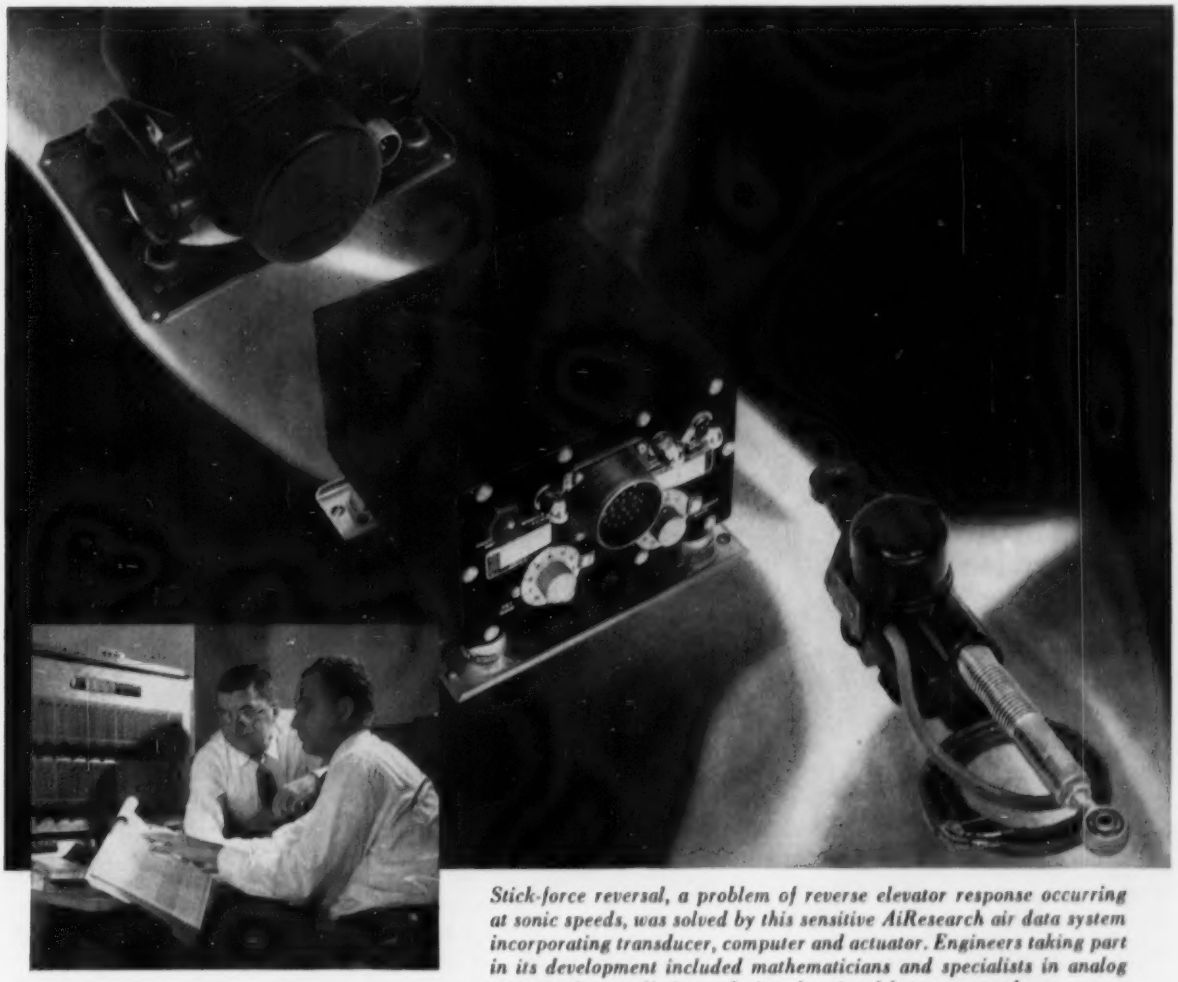

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Faculty Profile . . .

Prof. Dale R. Corson

Professor Dale Raymond Corson, the new chairman of the Physics Department at Cornell, began his physics career as an undergraduate at the College of Emporia in Kansas. He continued his studies at the University of Kansas where he earned his Master of Arts. More graduate work followed, first at Ohio State University and then at the University of California at Berkeley where he received his Doctor of Philosophy degree. Doctor Corson came to Cornell in 1946 as an assistant professor of physics, became an associate professor the following year, and a full professor four years ago.

One of his first notable achievements occurred in 1940 when he was studying radioactivity and cosmic rays at the University of California. By bombarding bismuth with alpha particles, he was able to synthesize a new element, an unstable halogen named astatine. During the war, Professor Corson did research for the Air Force on radar for night fighters and night bombers. He later worked on the development of a radar system used to locate surfaced enemy submarines. At Los Alamos' Scientific Laboratory, the professor helped found the Atomic Energy Commission's Sandia Laboratory at Albuquerque.

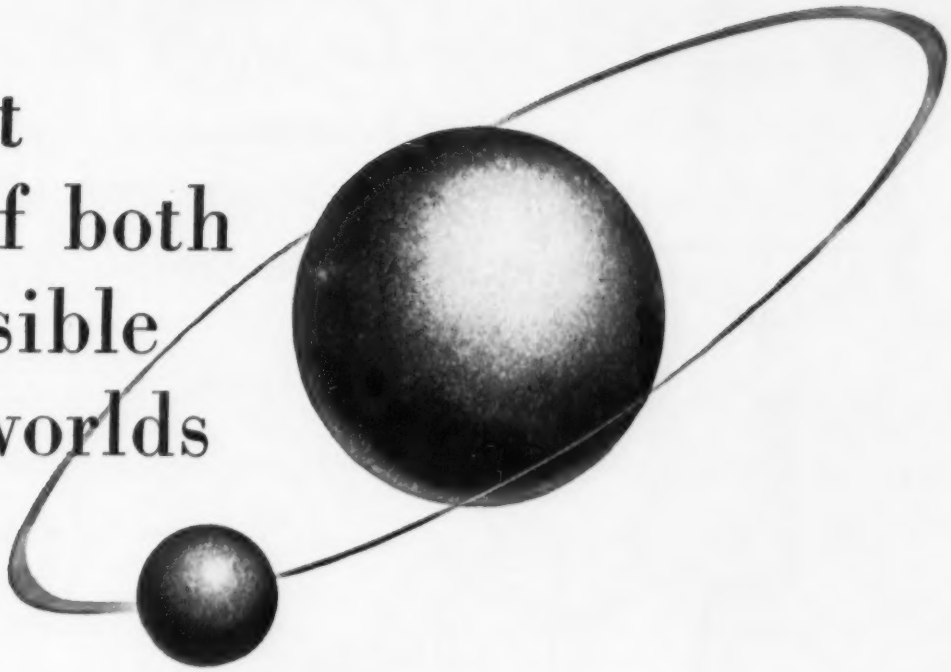
While at Cornell, Professor Corson has been using Cornell's synchrotron, a billion volt accelerator, to observe the interaction between particles, especially pi mesons. Professor Corson has worked on the resolution of the long standing conflict of the origin of light and X-rays given off by a synchrotron. He has also studied the scattering of high energy electrons by observing the amount of wiggle in the traces which are visible on photographic emulsions.

Until this year, Professor Corson taught only junior and senior engineering physics and physics major students. Last year however, Professor Tomboulian was on his sabbatical leave and Professor Corson was teaching Professor Tomboulian's course in magnetism, atomic physics and physical optics for sophomore engineering students. He surprised his class at his first lecture by using a microphone attached to a portable transistorized transmitter in his pocket which broadcasts to a tuner amplifier mounted on the front wall of Rockefeller "A." Two double horn university speakers transmit the lecture to the students. Professor Corson along with Professor Robert Sproul did most of the development work on this transmitter. Advice on the basic design came from the Bell Telephone Laboratories. Professor Sproul built the bread board models, and the final version was assembled in the electronics shop of the nuclear laboratory. Its dimensions are only 3½" X 3" X 1" and it is powered by a 15 volt battery which lasts about three weeks. Although vacuum tube models of this transmitter cost about $1000, the parts in this one cost less than $100. Professor Corson says that the danger of using a regular microphone is that the cable might get entangled in high voltage demonstration equipment, or other objects in the lecture room. Professor Corson's transmitter is certainly a boon to all who must lecture in cavernous Rockefeller "A."

Being department chairman reduces Professor Corson's teaching and research time. Despite this, graduate students under his supervision have done some admirable work. One graduate student who did work under him is now a professor at Harvard. Besides these personal satisfactions, Professor Corson has been honored with election to Phi Beta Kappa, Sigma Xi, and he has been named a fellow of the American Physical Society.

—Benson J. Simon

Best of both possible worlds



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In addition, the Company sponsors a thrift plan. For every dollar you invest in U. S. Savings Bonds, the Company sets aside 25 cents for the purchase of common stock in your name. Roughly 65 per cent of our 90,000 employees are now participating in this plan.

If you have specific questions on Du Pont benefits, just send them to me. I'll be happy to try to answer them. E. I. du Pont de Nemours & Co., Inc., Room 2504-A Nemours Bldg., Wilmington 98, Del.

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Engineers and scientists of all kinds work in 75 Du Pont plants and 98 laboratories scattered over 26 states. Where you're assigned depends on your qualifications and the openings in the kind of work you want.

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Right now, most of the Du Pont units are located east of the Mississippi, but there are plants in Texas, Colorado and on the Pacific Coast, too. And new building is under way in Kansas, Tennessee, Virginia and North Carolina.

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Community Life

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There's an engineer's

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world at Western Electric

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● To our engineers falls the monumental task of developing manufacturing operations and of planning the installation of telephone central office equipment across the nation. They devise the new machines, tools and methods needed to do our job. They also shoulder the major responsibilities in carrying out the defense contracts the government has asked us to take over – major projects like the Nike guided missile system and SAGE, the continental defense system.

● In the course of their technical work, engineers participate in such broad managerial functions as production, merchandising, installation, and many others. What's more, we have a record of promotions from within. It's not surprising, therefore, that fifty-five percent of the college graduates in our upper levels of management have engineering degrees.

● Naturally we do everything possible to encourage and speed the professional development of our engineers. Just recently, for example, we inaugurated a full-time off-the-job Graduate Engineering Training Program at special training centers, a program with few parallels in American industry.

● The new engineer moves into the first phase of this program, **Introduction to Western Electric Engineering,** four to six months after he joins us and devotes nine weeks of study to such technical subjects as communications systems, military electronic systems, product design principles. He takes part in the second phase, **General Development,** after the first year on the job. In this phase he devotes nine weeks to courses in human relations, semantics, engineering statistics, electronics, measurements and instrumentation, systems circuit analysis. The third phase, **Advanced Development** (4 weeks per year), is available to selected engineers and is geared to the individual to help develop his creative engineering abilities; goes deeply into such subjects as magnetics, computer applications, electronic switching, radar fundamentals, feedback control systems and technical paper writing.

● Besides this company-wide program, a number of our divisions offer individual engineering courses in their own specialties. We also sponsor a Tuition Refund Plan for out-of-hours study at nearby colleges. Open to all employees, this plan helps our engineers study for advanced degrees at Company expense.

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For further information write: Engineering Personnel, Room 1030, 195 Broadway, New York 7, N. Y.

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Polyethylene pipe

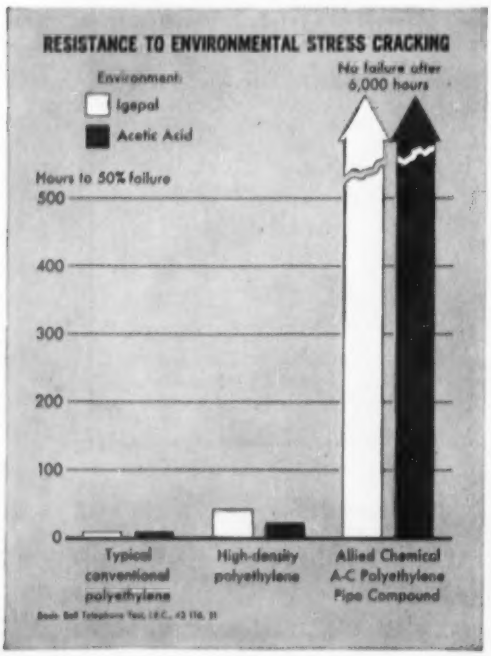
Flexible plastic pipe for water service and industrial applications. Chemical-resistant plastic pipe for transmission of solvents and hydrocarbons in the oil and gas fields. Pipe that is resistant to impact, heat and other stresses.

These are some of the advances made possible by a unique new polyethylene pipe compound developed by Allied Chemical. A very high molecular weight polyethylene, it is the successful culmination of 10 years of basic research at our Central Research Laboratories. It is now in commercial production.

Development work is now underway to find other uses for the resin's exceptional physical properties, for the time when the production rate permits sale beyond pipe manufacture. Likely candidates for new uses are tubings, films, sheets, tiles, moldings and fibers.

This distinctly different polyethylene resin made at low pressure is the best thing yet for extruding a superior polyethylene pipe. Pipe being made from the new A-C polyethylene pipe compound has high bursting strength, resistance to impact, shows no stress cracking, has superior heat resistance and resistance to chemicals, organic solvent and hydrocarbon liquids.

New plastic pipe made by Orangeburg Mfg. Co.



These properties are due to the high molecular weight — on the order of 750,000 — and structure of the polyethylene molecule, not present in any other known polyethylene. These new qualities will greatly expand the acceptance of plastic pipe for water service and industrial applications. A common fault of some polyethylene pipe has been environmental stress cracking; this is entirely overcome in pipe made of this new resin.

Also, tests indicate the pipe will be suitable for carrying solvents and hydrocarbons for oil and gas pipe lines, a use denied to conventional polyethylene pipe. There is a growing need in this field for a flexible, tough pipe, resistant to the corrosive conditions which attack steel pipe.

A-C polyethylene pipe compound has an unusually high melt viscosity, reflecting its great molecular weight, and requires special techniques for manufacture of pipe.

The new resin is a companion product to a line of low molecular weight polyethylene products introduced on a commercial scale in 1954 by Allied. These are used in the injection molding of many household items, and as additives in paper coatings, polishes and printing inks.

A-C is an Allied Chemical trademark

Ammonia data book

A new 68-page technical book on ammonia has been prepared by the largest ammonia producer, Allied's Nitrogen Division.

The comprehensive manual is actually a two-in-one piece: the first section on ammonia, and the second on ammonia liquor. Its contents include major uses, physical and chemical properties, specifications, shipping and storage procedures, physical tables, graphs and analytical procedures.

Major ammonia consumers — industries such as explosives, textiles, petroleum refining, refrigeration, pulp and paper, metallurgy and synthetic resin — will be interested in this up-to-date information.

Creative Research

These examples of product development work are illustrative of some of Allied Chemical's research activities and opportunities. Allied divisions offer rewarding careers in many different areas of chemical research and development.

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CORNELL RADIOLOGICAL LABORATORY

The fallout problem of thermonuclear weapons has necessitated the installation of a radiological laboratory at Cornell. This laboratory, established by the New York State Civil Defense Commission, will serve to test the long-range safety of water which has been subjected to intense radiation.

The radiological laboratory at Cornell is one of five such installations in New York State. The other stations are located in Morrisville, Alfred, Poughkeepsie, and Middletown.

The Cornell laboratory, under the direction of Professor Charles D. Gates, operates with apparatus valued at more than five-thousand dollars. It is made up of two basic components: the radiation detector and the counter.

The radiation detector is a lead shielded Geiger tube into which radioactive samples are fed automatically. The automatic feeding device can hold up to 25 samples. These samples are placed on a turntable which, when loaded, shoves each item to be tested into the detector; repeating the cycle as many times as desired.

The counting device can be preset so that each sample remains under the detector for a given length of time or for a given number of counts. In the former case, the number of counts would be recorded on a tape while in the latter instance the length of time would be measured.

The laboratory facilities also include a special monitor. This device is similar to the ordinary "Geiger-Counter" and is used to make certain that workers are not exposed to dangerous doses of radiation.

At present the test center is housed in Lincoln Hall. However, when the Civil Engineering School moves to its new quarters, the apparatus will be setup in a room specially designed to accommodate it.

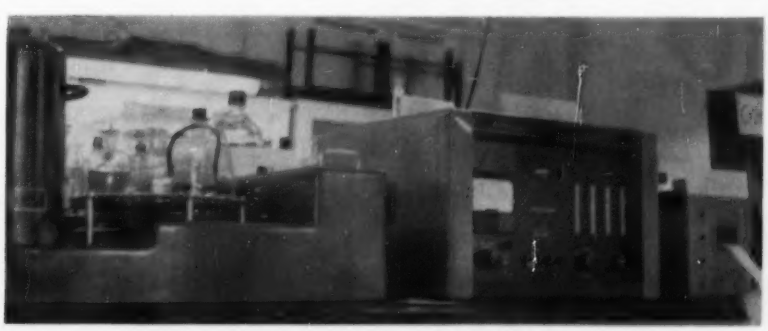
Although the New York State Civil Defense Commission requires that the laboratory be available for civil defense use in the event of a nuclear attack, the University is free to make use of the equipment for research work at all other times. At present Professor Gates and his assistants are studying the radioactive content of soil and water samples in Ithaca and the vicinity.

It has been observed that the radioactive content of bodies of water increases significantly immediately after atomic tests. The radioactive content is, of course, far below dangerous levels. It is interesting to note that this marked increase in the radioactivity of the water has provided us with information regarding Russian atomic tests. The radiation tests now being made will serve as a source of comparison for tests to be made at a later date.

In the event of a nuclear attack, the laboratory will test water for long-range use. Water that is to be used within thirty days may be tested by an ordinary Geiger Counter. It is also possible for the laboratory to test milk samples.

Of course, it is hoped that these testing facilities will never be needed for such an emergency. However, they will still be put to good use at Cornell for radiotracer studies as well as other projects.

—Alan S. Rosenthal



Array of equipment used for radioactive testing.

This can be YOU

Frank Kovalcik, Purdue '48, Covered 24,000 Miles in 1956 as Western Editor of ELECTRICAL WORLD

IF YOU'RE LIKE MOST PEOPLE, you think of an editor as a man who's "chair-borne" most of the time . . . tied to a desk at an indoor job.

Nothing could be further from the facts when it's a McGraw-Hill editor you're thinking about. Frank Kovalcik, Western Editor of McGraw-Hill's ELECTRICAL WORLD Magazine, can quickly tell you that. He's anything but a desk man . . . covers 11 states and part of Canada. Frank says:

"In 1956, I made eight major field trips, covered close to 24,000 miles. I was underground in a transformer vault in Los Angeles, inside a diversion tunnel in Idaho, atop a steel transmission tower in northern California. Projects visited included The Dalles multi-purpose project, Hoover Dam, Hells Canyon, and even behind the scenes (electrically) at the Republican National Convention. But none of them can touch the "Operation CUE" A-Bomb test I covered a year ago!

"My chance to witness the detonation of a nuclear device came when the Federal Civil Defense Administration and the A.E.C. decided to test non-military effects of the blast. I reported on what happened to electrical utility lines and equipment."

(*Frank wouldn't say so, but his story set a record . . . from explosion to editorial pages in four days! The pictures at right were part of his original coverage of this fast-breaking—"hot"—news story for his magazine.*)

McGraw-Hill As A Place to Work

Frank can tell you about this, too:

"My first editorial job—with the *Purdue Exponent* in college—didn't use my engineering training, but it showed me the way to communicate what's new in engineering . . . to report and interpret the work of engineers for the benefit of other engineers.

"When I got my B.S. in E.E. I started with ELECTRICAL WORLD in New York. Within a year I was promoted to Assistant Editor and made responsible for a department of the magazine. Before the big jump to San Francisco as Western Editor in '54 I served briefly as assistant to the managing editor.

"As Western Editor my search for news takes me into all important phases of the electric utility industry—and into association with top management and engineering men. Working with them is a constant reminder that the choice of an engineering-editorial career was the right one for me."

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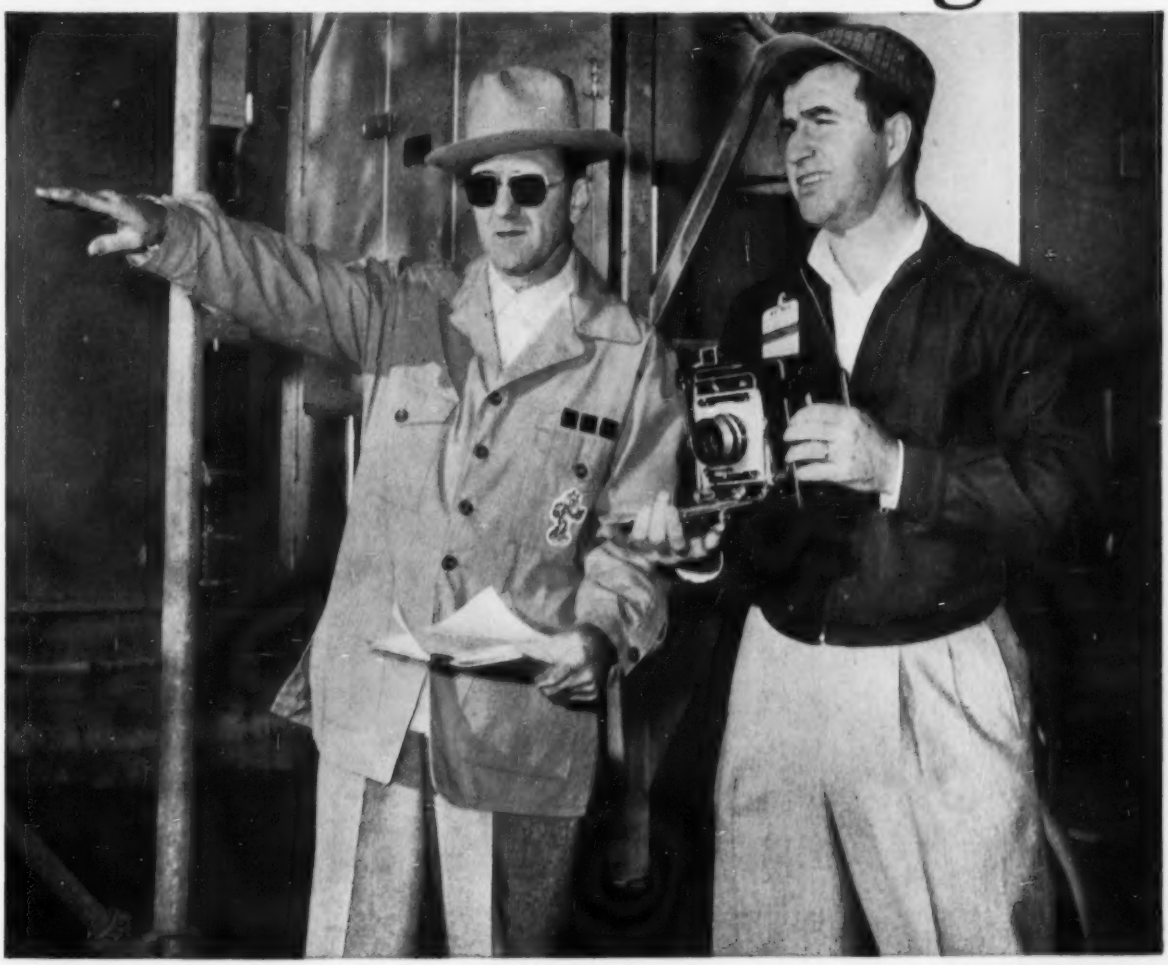
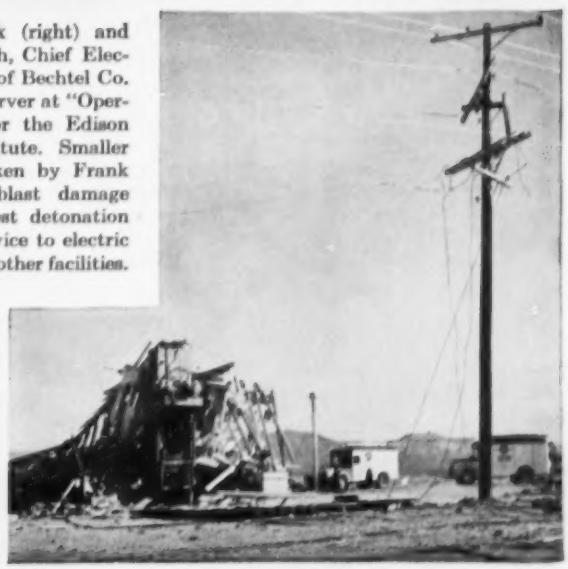


Frank Kovalcik (right) and Karl M. Bausch, Chief Electrical Engineer of Bechtel Co. and official observer at "Operation CUE" for the Edison Electrical Institute. Smaller illustrations taken by Frank show typical blast damage caused by a test detonation of a nuclear device to electric utility lines and other facilities.



ALUMNI ENGINEERS

E. A. Miller

E. A. Miller, C.E. '37, was elected Vice President in Charge of the newly-established Building Products Division of Fenestra Incorporated.

Miller, who received both his Civil Engineering and Master of Civil Engineering degrees from Cornell, joined Fenestra Incorporated in 1943 as a research engineer at the company's Detroit plant. He was promoted to chief engineer at the Buffalo, N.Y., plant in 1946 and, three years later, was named Manager of the Panel Division at Fenestra's Detroit headquarters.

A member of the American Society of Civil Engineers, Miller currently is president of the Metal Roof Deck Technical Institute. He was secretary-treasurer of the institute from 1946 to 1955.

His engineering fraternities include Tau Beta Pi and Sigma Xi. He is a member of Delta Chi and is chairman of the Sir Edward Coke Educational Foundation of the Cornell Chapter.

Mr. and Mrs. Miller and their four children reside at 827 Whittier Road, Grosse Point Park, Grosse Pointe, Michigan.

Daniel C. McCarthy, M.E. '49, is assistant to the director of manufacturing of Chrysler Corp. He lives at 17158 Evergreen Rd., Detroit, Mich.

Harold E. P. Barta, BS in AE '35, has been appointed manager of the project engineering sales division of Pfaudler Co. of Rochester, manufacturers of glass steeled processing equipment. He formerly was director of overseas selling for Sharples Corp.

James Van Deusen Eppes, M.E. '31, is associate professor of mechanical engineering at Lehigh University, Bethlehem, Pa. He left MIT in 1950 to assume his present position. He is faculty adviser of the Cosmopolitan Club of Lehigh. His address is 447 Hikewilder Place, Bethlehem, Pa.

Thomas W. Hopper, M.E. '28, has been elected president of Day and Zimmerman, Inc., an engineering firm. He has been with the organization since 1941, and became its executive vice-president last August. Previously he was director of engineering for the company. He is a member of the American Society of Mechanical Engineers, the Franklin Institute, The Engineer's Club of Philadelphia, and is past president of the Cornell Society of Engineers. Presently he is chairman of the Engineer's Joint Council Committee on Employment Practices. His address is 10 Dogwood Lane, Swarthmore, Pa.

William M. Skull, M.E. '24, is director of manufacturing services of B. F. Goodrich Co., Akron, O. He is an active member of the Chamber of Commerce, Rotary, and Community Chest. His address is 371 Dorcheste Rd., Akron 20, O.

Albert A. E. Bock, M.M.E. '49, has been promoted to manager of product engineering at the Grafton, Mass. plant of Wyman-Gordon Co. He joined the company in 1949 as a research and development engineer. He took a metallurgical trainee course in 1950 and was appointed supervisor of methods and engineering in 1951 and supervisor of product engineering in 1954. He lives at 78 Jamieson Rd., Holden, Mass.

Joseph Delibert

Joseph C. Delibert, C.E. '36, has been transferred from the advertising department of The Babcock & Wilcox Company to the firm's Boiler Division sales department, where he has been named sales promotion and training manager.

Mr. Delibert joined B&W's marine engineering department in Barberton, O., in 1936, as stress analyst. One year later, he was transferred to New York, where he was employed in marine boiler design and sales. He moved to the advertising department in 1946 and was made assistant advertising manager in 1955.

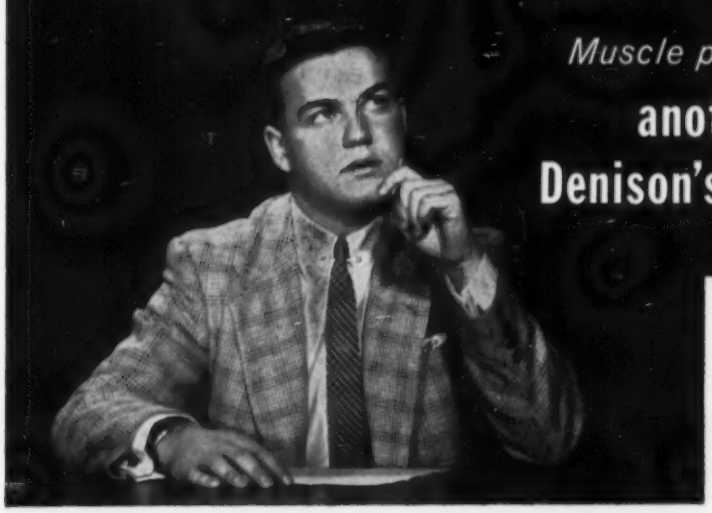
While with the Marine Division, Mr. Delibert worked on a number of special assignments, including Mercury Boilers, land and sea tests for Steamotive Boilers and the company's merchant and naval boiler programs during World War II.

He is a recipient of The Fuertes Medal for scholastic achievement. Mr. Delibert is a member of the Cornell Club of New York, the American Society of Mechanical Engineers, the Sales Executive Club of New York, the Engineers Club, and of Tau Beta Pi and Chi Epsilon.

Mr. Delibert is currently residing at 38 Winter St., Lynbrook, L.I., N.Y.

(Continued on Page 67)

HYDRAULICS IN YOUR FUTURE



Muscle power for a ghost engine...

another example of Denison's hydraulic ingenuity

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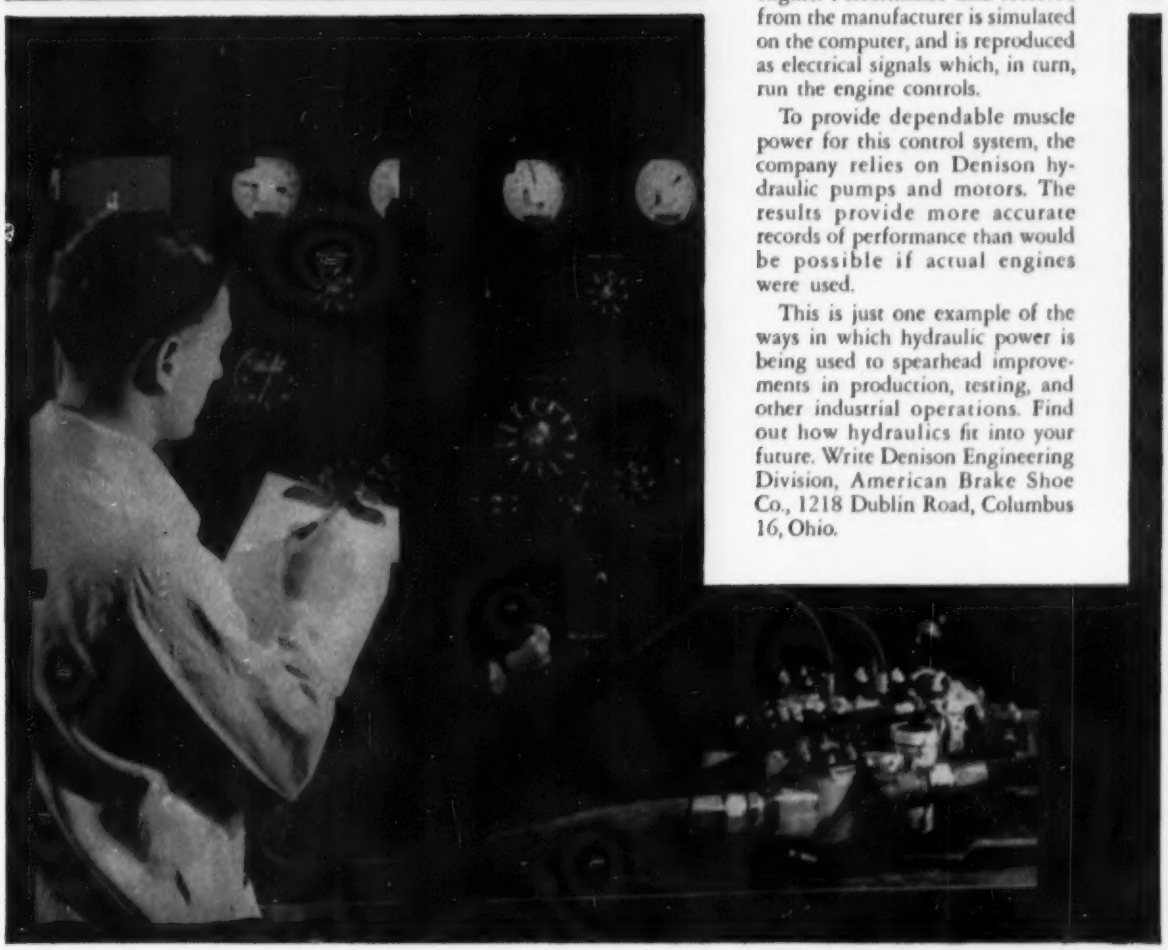
In the system, an analog computer takes the place of the jet engine. Performance data received from the manufacturer is simulated on the computer, and is reproduced as electrical signals which, in turn, run the engine controls.

To provide dependable muscle power for this control system, the company relies on Denison hydraulic pumps and motors. The results provide more accurate records of performance than would be possible if actual engines were used.

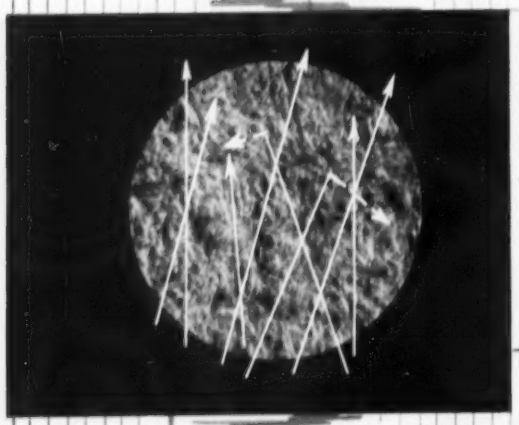
This is just one example of the ways in which hydraulic power is being used to spearhead improvements in production, testing, and other industrial operations. Find out how hydraulics fit into your future. Write Denison Engineering Division, American Brake Shoe Co., 1218 Dublin Road, Columbus 16, Ohio.



Look to **DENISON** *for leadership in hydraulic development*

DENISON HydrOILics

How much does green weigh?



An Industrial Engineer's analysis of an unusual application of atomic energy recently became a valuable contribution to our manufacturing efficiency. His assignment was to evaluate a nuclear gauging system for controlling saturants—one of which is green—used in felt backing for linoleum.

Through use of radioisotopes, or Beta Gauges, the green saturant is now continuously controlled by percentage of weight while it is actually being processed. This was previously impossible. Using one of the most advanced methods in the field, the Armstrong Industrial Engineer determined the economic practicality of this use of radiation and has given Armstrong a reliable insight into future results that can be expected from Beta Gauges.

This use of statistics and modern sampling techniques is an example of the creative approach used at the Armstrong Cork Company to increasingly complex problems in the field of Industrial Engineering. It represents one of many interesting assignments that new Industrial Engineers at Armstrong can expect following eight weeks of individualized instruction at the Company's Industrial Engineering Center.

For a wide range of assignments, consider the Armstrong Cork Company in planning your Industrial Engineering career.

See your placement officer or write for the illustrated booklet, "Careers in Business."

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Armstrong Products for home and industry . . . Building Materials and Resilient Flooring, Industrial Specialties and Packaging Products.

CAREERS WITH BECHTEL

JAMES F. DEL CURO, *Mechanical Engineer, Power Division*

MECHANICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *As I understand it, Mr. Del Curo, the Power Division is concerned with the engineering phases of steam-electric generating plants?*

DEL CURO: That's true. Our own department is specifically concerned with the mechanical engineering phases of such plants.

QUESTION: *When the engineering graduate joins your department are his starting duties standard?*

DEL CURO: Yes. The routines are pretty well defined. We know a man learns best by actual doing, so he is put to work immediately on heat balances, line size calculations, specifications, miscellaneous and minor auxiliary equipment, instrument data sheets and information for plant data books.

QUESTION: *In other words, you sort of throw the man in and he has to learn to swim by himself?*

DEL CURO: No. He has plenty of help. He works under the direct supervision of a job engineer or the mechanical group supervisor.

QUESTION: *How long does this training phase last?*

DEL CURO: That will vary with the man, since aptitudes and desires to learn are different. The average is somewhere between a year and eighteen months.

QUESTION: *During this period he will gradually advance to more complicated equipment?*

DEL CURO: Yes. For example, after a while he will be doing original work on heat balances and system studies. He will be able to take an entire "piece" of a project and handle it on his own responsibility. He will become involved with bigger equipment and with the overall aspects of the power plant. Somewhere along the line he will likely be assigned to try his hand at piping materials, piping specifications and combined control specifications.

QUESTION: *What about the man who wants to specialize?*

DEL CURO: If, for example, a man shows a particular interest in steam turbines, instrumentation or control, and demonstrates a special aptitude for one of them, he will often be called on to work on that specialty, without being confined to it exclusively. Thus we encourage specialization, even during the training period, but also make sure that the young man gets overall experience through work in all phases of mechanical engineering.

QUESTION: *What about field experience?*

DEL CURO: That is, of course, highly desirable from his standpoint and ours. We make every effort to assign the young engineer to field work as soon as possible.

QUESTION: *What will he do in the field?*

DEL CURO: When we are building a power plant we try to get the young engineer on the job five or six months before the scheduled start up of the plant. He will actually help the chief start up engineer by writing up procedures, planning the hydraulic washing to steam lines, working on the start up of each piece of the equipment, checking out controls, etc.

He will also handle paper work such as filling out the data sheets that are later turned over to the plant operators to aid them in running the plant. By the time the turbine is rolled and the job ends, the young engineer has been able to see the end result of all the engineering work he and others have done back in the office.

QUESTION: *Are there any other types of field assignments?*

DEL CURO: If the young engineer desires such experience, he is sometimes used in the construction department if that group is shorthanded.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering—Mechanical . . . Electrical . . . Structural . . . Chemical . . . Hydraulic.

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Synthane is valued in electrical applications chiefly for its high dielectric strength, low moisture absorption and low dissipation factor plus its additional properties of dimensional stability, machinability and mechanical strength. Synthane is available in over 30 standard grades in sheet, rods, tubes or you can avail yourself of our complete fabricating services.

For more information about the many properties of Synthane and how you can benefit by using Synthane materials and fabricating services, write for our product catalog. Synthane Corporation, 13 River Road, Oaks, Pennsylvania.

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SYNTHANE ... industry's unseen essential

SYNTHANE CORPORATION, 13 RIVER ROAD, OAKS, PA.

ALUMNI ENGINEERS

(Continued from page 62)

Franklin A. Reed, ME '22, has been elected vice-president in charge of sales of Niagara Machine & Tool. Previously he was sales manager and a director of Niagara since 1945. He joined Niagara in 1924, two years after his graduation from the University.

Edwin A. Munschauer, Jr., ME '41, is Niagara Machine & Tool Works new treasurer and a new director. Service manager of the Company since 1941, and in its employ since 1936, Mr. Munschauer is also a grandson of the company's Founder.

All officers are directors of the Company.

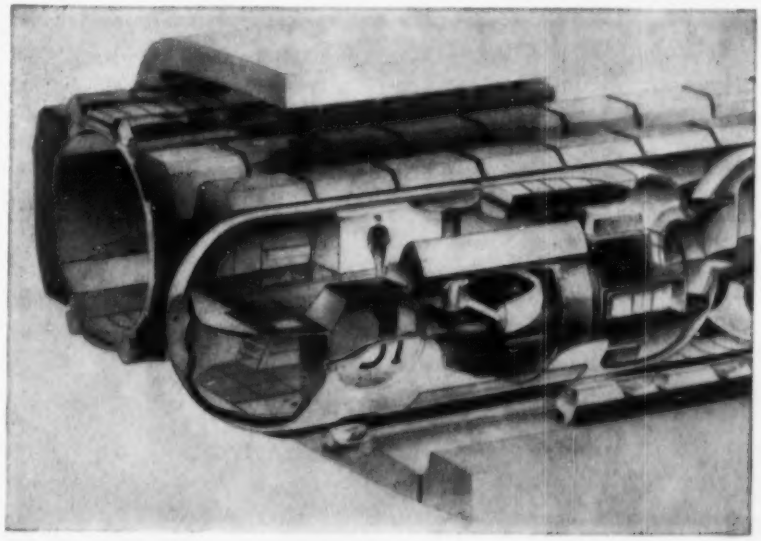
Reginald H. Keays, 'C.E., '95, is retired and lives at 451 N.E. Fifty-second Street, Miami, Fla.

William L. Cressman, C.E., '27, '28, is assistant general manager of product divisions, Jones & Laughlin Steel Corp., Pittsburgh, Pa. He was formerly manager of Eastern sales, Armco Steel Corp., Middletown, Ohio. Cressman lives in Pittsburgh at 6236 Fifth Avenue, Apartment 101.

Richard D. Beard, '46, 308 Lansdowne Road, Dewitt 14, was transferred about a year ago to the assignment which he now holds as service specialist, component products. He writes that his family, including David 6, Barbara 4, and Sharon 2, likes the new central New York home very much. **Walter W. Eberhardt,** 529 Daytona Parkway, Dayton 6, Ohio, is a sales engineer for Aluminum Co. of America. He has a baby daughter, Susan Jane, born July 31.

Frank A. Ernandes, along with 200 other men from 75 other universities, has been awarded a Master of Science Fellowship from Hughes Aircraft Co., which enables him to work toward the MS at University of Southern California in Los Angeles while employed part-time in Hughes research and development laboratories.

MARS outstanding design **SERIES**

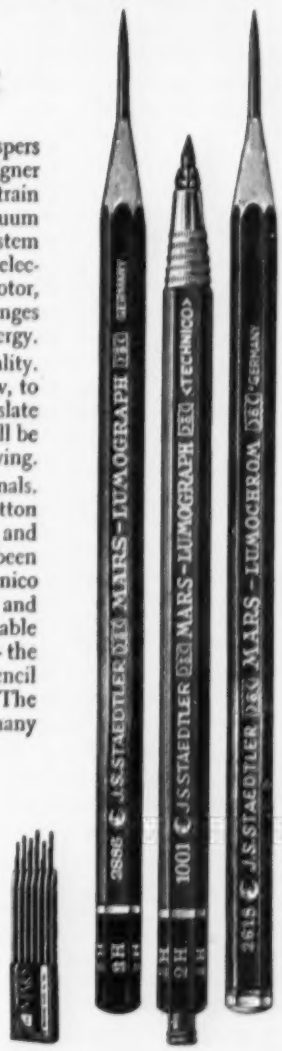


man and motion:

The wonders of the future are still little whispers in men's minds, or maybe — like Detroit Designer Norman James' magnetically suspended inter-city train — a drawing on a piece of paper. Traveling in a vacuum in an air-tight tube, it floats in space, held by a system of magnets built into cars and tunnel. Propelled electrically by "rolled-out" motor, train acts as rotor, tunnel roof as stator. Converter aboard train changes light projected through windows into electrical energy.

No one knows which ideas will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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COLLEGE NEWS

ENGINEERS' DAY BANQUET

The annual Engineers' Day Banquet was held at the Clinton House on Sunday evening, May 5, to culminate the weekend of activities connected with Engineers' Day. Prizes were awarded to outstanding students for their accomplishments over the past year. Professor Dexter Perkins spoke to the group about the relative strengths of the Soviet Union and the United States today.

The awarding of prizes began with Professor Erickson's presentation to Jeffrey Frey the Eta Kappa Nu award for the electrical engineering sophomore with the highest average in his freshman year. He also presented the electrical engineering Sibley prizes for the highest four year averages to Herschel Loomis and Peter November. Professor Rosson next presented several public speaking awards. The AIEE-IRE public speaking award was won by Larry Phillips. Dick Hildreth and Dick Knoeller were second and Robert Gale was awarded third prize. Larry Phillips also won the Fuertes Public Speaking prize.

Professor Christensen presented the Fuertes Medal to Douglas Merkle, the fifth year student with the highest average in Civil Engineering. Professor Hough gave the Charles Lee Crandell Prize to Paul Bullock for his paper "Scribing on Plastics."

Professor Loberg, director of the School of Mechanical Engineering, presented the Sibley Prizes to Hanokh Shekhter and Souren Hanessian. The Atmos award for the best fifth year student in machine design went to Don Malcolm and Cartan Kraft.

Professor Winding presented to Michael Midler the AIChE Award for the junior chemical engineering student with the highest two year average.

The Silent Hoist and Crane Company Materials Handling Prizes were presented by Mr. McManus,

Engineer's role in producing the E-day program is commended at Engineer's Day Banquet.

Assistant Dean. These prizes are awarded for the best original papers on materials handling. Carl Miller was the recipient of the first prize. Henry Paulsen was second and Herschel Loomis and Peter November, third.

The final award was for the school with the best E-Day exhibit. It was won again this year by the School of Electrical Engineering.

After the awards presentations, Dean Hollister made a few comments on the importance of a broad education with self-improvement and criticism to keep the standards of the College of Engineering high.

Professor Perkins' talk, which concluded the program, was called "A Balance Sheet of Soviet-American Diplomacy." He enumerated and explained the advantages and disadvantages of America's present position in the relations with the Soviet Union, particularly emphasizing the economic and military aspects of our position.

DEAN'S HONOR LIST

In order to be included on the College of Engineering Dean's Honor List, an engineering student must maintain an overall eighty-five average or better over an entire scholastic year. The following students in the Schools of Mechanical Engineering, Civil Engineering and Engineering Physics have been placed on the Dean's Honor List for their academic performances during the past scholastic year.

Mechanical Engineers: Saul Blumenthal, Richard George Brandenburg, David Martin Dawson, Francis Barrett DeGress III, L. Walter Deitrich, Marc Fishzohn, Alan Morris Gast, Gerald Barker Gilbert, Robert Francis Guasta, Richard Mitsugu Hamada, Souren Hanessian, Jr., Charles Hawks III, Herbert Peter Hess, Edward Joel Ignall, Thomas Ward Kemp, Richard Allen Kneen, Lawrence Lasher, Scott Carney Lewis, Alan Lippert, Bion Walton McClellan, Bruce David Marcus, David Paul Maurer, William Laughlin Maxwell, Robert Clarence Metzger, David Benson Mitchell, Paul Julian Mode, Jr., David Edward Mott, Robert Christian Pfahl, Jr., Howard Milton Picking, James G. Rae, Donald Rockwell, H. Marshall Shambarger, Jeremy Frank Shapiro, Robert Shaw, Jr., Hanokh Shekhter, John Lee Spivak, Owen James Stevens, Howard Milton Taylor III, Robert Vernon Wagoner, Jr., Morris Boris Yaguda.

Civil Engineers: Donald G. Armstrong, Stuart C. Edelberg, David S. Fuss, Peer Ghent, Floyd A. Henehan, Nathan L. Jaschik, David N. Koppes, Carl B. Loutzenheiser, Robert S. Queener, Martin H. Sahn, Lawrence E. Santucci, Jr., Arthur Scheinuk, Jr., Richard A. Shigekane, Robert G. Spicher.

Engineering Physics: John F. Ahearne, Robert Wade Allerton, Robert Henry Armsby, Robert T. Braden, Charles Allen Brau, Oscar M. Browne III, Gary Kenneth Cowell, Robert N. D'heedene, Frans M. Djorup, Jr., Richard Dolen, William B. Easton, Julius Feinleib, William A. Friedman, David L. Galbraith, Gene M. Gilliland, Michael A. Goldman, Peter M. Goldreich, Paul Gorenstein, Paul Dutton Gran-

nis, Michael P. Greene, Richard A. Handelsman, Erik Preston Harris, Lewis Mankin Hobbs, Lawrence Steven Iwan, Robert Harris Kantor, Allan Shale Krass, James A. Larrimore, Ben Edward Lynch, Lloyd D. Malmstrom, Michael S. Martin, James Henry McNally, Peter Herbert Mengert, Linn F. Mollenauer, Park S. Nobel, Edward Ernest Pilat, Douglas Arthur Pinnow, Alan W. Riddiford, William R. Roach, James C. Rushing, Frederick Emil Schmitt III, Gerald Schubert, Paul Grant Seybold, Joseph F. Terdiman, Robert E. L. Turner, Charles W. Van Way III, Robert W. Weinman, Philip R. Yarnell.

ENGINEERING SOCIETIES

Tau Beta Pi, national engineering honorary, elected the following officers for the new term: Scott Lewis, president, Richard Shigekane, vice president, Robert Steele, recording secretary, Guy Henry, corresponding secretary, Saul Blumenthal, treasurer, Marsh Shambarger, cataloger, and Dick Allman, social chairman. The winner of the pledge essay contest was Jeff Gorman. His essay was entitled, "Public School System in the United States."

Pi Tau Sigma, mechanical engineering honorary, announced the election of the following officers: Robert W. Staley, president, Clayton W. Chapman, vice president, Marsh Shambarger, corresponding secretary, Saul Blumenthal, treasurer, and Richard Peterson, recording secretary. The primary function of the honorary is to tutor freshmen engineers.

The membership of the **Society of Automotive Engineers** elected Philip Forde the new chairman and John Miniutti the program chairman.

Beginning Tuesday, October 8, the **American Society of Agricultural Engineers** will hold meetings every second and fourth Tuesday of the month at 7:30 in the evening in Riley-Robb Hall. The Society is planning a variety of programs for the fall, with guest speakers at many of the meetings.

There are two types of membership possible in the Society. Professional membership status may be held only by Ag Engineers, but any interested person can be an Associate member. Students interested in joining the Society should contact Pete Oettinger, the membership chairman. The new president is Ted Rad.

SCHOLARSHIP AWARDS

Ferdinand Rodriguez, a graduate student at Cornell University, has been awarded a fellowship by the Eastman Kodak Company to study chemical engineering at Cornell next academic year.

The grant provides tuition and fees and an additional $1,000 to help defray research expenses. The program was started by Kodak in 1939 to encourage research training of promising young scientists and engineers studying for the Ph.D. degree. Rodriguez holds B.S. and M.S. degrees in chemical engineering from Case Institute of Technology.

Two Cornell NROTC Midshipmen have been named among 30 recipients of the annual Society of American Military Engineers Gold Medal Awards; **Midshipman Herschel H. Loomis,** of the School of Electrical Engineering, and **Midshipman Charles R. Tevebaugh,** a student in the School of Chemical Engineering. This marks the second year that Midshipman Loomis has received this award, and also the second year that Cornell has been able to claim two recipients.

The purpose of the award is to impress upon undergraduate engineering students, by appropriate recognition of meritorious promise of achievement in the field, the importance of engineering to national security. The medals are awarded annually to fifteen last year students, and fifteen next-to-last year students selected from nominations of "Outstanding Engineering Student of the Year of His Group" from the 53 colleges and universities throughout the country having Naval ROTC units. Selections are made by a board of naval officers convened by the Chief of Naval Personnel.

Elliott M. Glass, a senior at Cornell University, has been awarded a Fulbright scholarship to study architecture at the Finnish Institute of Technology in Helsinki during next academic year.

Mr. Glass is the son of Mr. and Mrs. Milton Glass, 33 East 208 Street, New York City. He is a graduate of the Bronx High School of Science.

PROF. SMITH NAMED ASSISTANT DIRECTOR

Appointment of Prof. George V. Smith as assistant director for metallurgical engineering in the School of Chemical and Metallurgical Engineering at Cornell was announced by President Deane W. Malott.

An authority on the properties of steels at high temperatures, Dr. Smith joined the Cornell faculty in 1955 as Francis Norwood Bard Professor of Metallurgical Engineering.

Professor Smith was a research metallurgist with the U.S. Steel research laboratory at Kearny, N.J. from 1941 until coming to Cornell. While with U.S. Steel he taught graduate night courses in metallurgy at Brooklyn Polytechnic Institute.

He has written many technical articles and a book, "Properties of Metals at Elevated Temperatures" which was published in 1950. He is active in a number of technical committees including the subcommittee for aircraft structural materials under the National Advisory Committee for Aeronautics and a panel on high strength steels under the Materials Advisory Board.

Professor Smith graduated from the Carnegie Institute of Technology in 1937 and received a Ph.D. there in 1941. He is a member of the American Institute of Mining and Metallurgical Engineers, of the American Society for Metals, and of the American Society for Testing Material.

START TODAY TO PLAN TOMORROW

By knowing about some of the projects underway at the Babcock & Wilcox Company, an engineer may see his personal avenues of growth and advancement. For today B&W stands poised at a new era of expansion and development.

Here's an indication of what's going on at B&W, with the consequent opportunities that are opening up for engineers. The Boiler Division is building the world's largest steam generator. The Tubular Products Division recently introduced extruded seamless titanium tubing, one result of its metallurgical research. The Refractories Division developed the first refractory concrete that will withstand temperatures up to 3200 F. The Atomic Energy Division is under contract by the AEC to design and build the propulsion unit of the world's first nuclear-powered cargo vessel.

These are but a few of the projects — not in the planning stage, but in the actual design and manufacturing phases — upon which B&W engineers are now engaged. The continuing, integrated growth of the company offers engineers an assured future of leadership.

How is the company doing right now? Let's look at one line from the Annual Stockholders' Report.

CONSOLIDATED STATEMENT OF INCOME
(Statistics Section)
(in thousands of dollars)

1954	1955	1956—UNFILLED ORDERS (backlog)
$129,464	$213,456	$427,288

B&W engineers discuss developments in the Universal Pressure Boiler.

Ask your placement officer for a copy of "Opportunities with Babcock & Wilcox" when you arrange your interview with B&W representatives on your campus. Or write, The Babcock & Wilcox Company, Student Training Department, 161 East 42nd Street, New York 17, N. Y.

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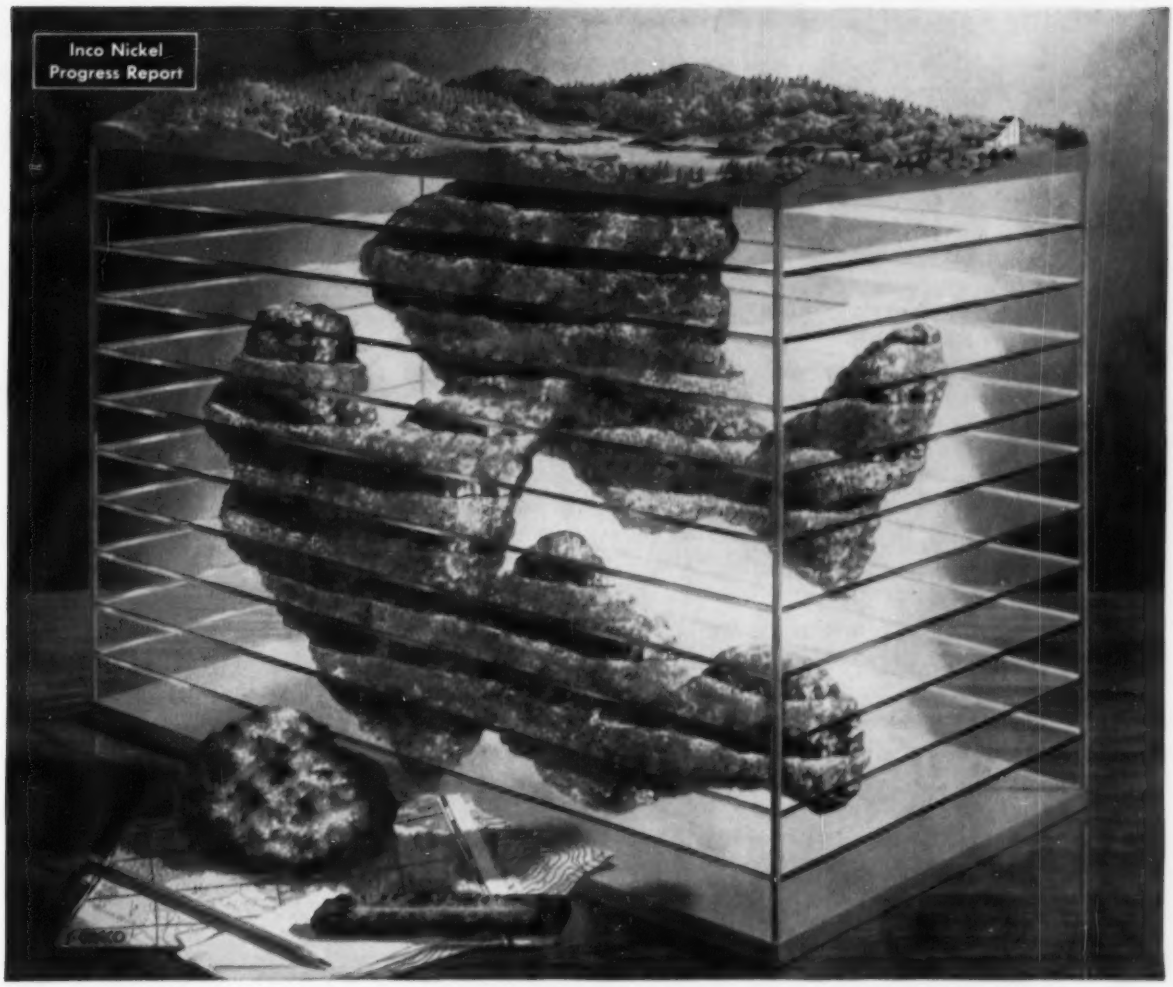

Inco mine engineers construct a 3-dimensional "picture" that shows where new, untapped ore bodies lie.

This 3-D model of an ore body shows where future supplies of Inco Nickel will be mined

How do Inco engineers keep a mine "alive"? For one thing, they try to learn as much as possible about the location of ore for the future.

New levels—new exploring

As soon as they open up *new* levels, the engineers start up exploratory drilling, to probe and "feel" in many directions.

Their hollow-shafted drills bring out specimen cores that show where there is worthwhile ore and where only worthless rock.

Hundreds and hundreds of ore samples

These ore samples enable International Nickel engineers to build small models of their mines' ore bodies. So they know where each ore body lies, how large it is, and of what grade.

They know, as well, how to get that ore out of the ground in the safest, most sensible, most economical way possible—know what shafts may have to be sunk, what tunnels and drifts to drive. Know, in a word, how to reach and mine every possible ton of usable ore. And, having mined it, how to extract every possible pound of useful metal.

Reserves—at new highs

Today Inco has larger reserves than ever before – although some of this ore lies a mile or deeper underground. And the Company also reports another fact: its multi-million dollar "mine-more" program makes possible today's high output of Inco Nickel. And looking to the future—in 1961, Inco Canada's Nickel output should be 385 million pounds a year. A hundred million more than in 1956!

"Mining for Nickel," color film, is loaned to technical societies, universities, industry. The International Nickel Company, Inc., Dept. 143f, New York 5, N. Y.

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INCO International Nickel

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

Highlights of your future with Honeywell

Glenn Seidel, Vice President in Charge of Engineering, BME, Minnesota, '36

The many

People, Places, Projects

"The story of Honeywell, as I know it, is a story of growth—from a thermostat to over 12,000 products; from a handful of employees to more than 30,000; from a basement in Minneapolis to a world-wide organization. For Honeywell, world leader in automatic controls, has expanded as rapidly as this exciting field. And employment, sales and income have increased steadily year after year.

"The future is even more challenging. Planned diversification puts Honeywell in such new fields as office and factory automation, process control, plastics, atomic energy, electronics, missiles and satellites. Whole new areas of opportunity are waiting for today's engineering graduates in each of Honeywell's divisions. Here are some division representatives to tell you about them."

CORPORATE RESEARCH
HOPKINS, MINNESOTA

Dr. Finn Larsen, PhD,
Iowa State, 1948
Director of Corporate Research

"Our Research Center is a focal point for Honeywell's over-all research program. Here, Honeywell scientists and engineers conduct basic research into areas such as Heat Transfer, Metallurgy, Thermodynamics, Solar Energy, Radioactivity, Electronics, etc. This research supplements other research carried on by Honeywell's separate divisions, plays an important part in the company's development program. There's certainly plenty of opportunity for the imaginative scientist or engineer here."

AERONAUTICAL DIVISION
MINNEAPOLIS; LOS ANGELES;
ST. PETERSBURG

E. H. Olson, BA,
U. of Minnesota, 1937
Director of Aero Engineering

"In the past six years our engineering force has trebled through our expansion into such advanced fields as inertial guidance, jet engine control, computers, fire control and bombing systems, fuel management, and precision gyros. We have developed and produced more autopilots than any other manufacturer, and built the reference system for the Earth Satellite Rocket. The diversity and wide acceptance of our products indicates the boundless opportunities we have for engineers and scientists."

ORDNANCE DIVISION
MINNEAPOLIS; SEATTLE;
MONROVIA, CALIF.

Clyde A. Parton, BSEE,
U. of Alabama, 1940
Director of Ordnance

"Here at Honeywell Ordnance we're putting all our experience and imagination into maintaining America's technological lead. We work in such new fields as infrared sensors, missiles, servo mechanisms, new types of turret control systems. We've developed proximity and mechanical fuzes, antiaircraft fire control systems, underwater warfare equipment and other products in widely diversified fields. Our more advanced products, naturally, are still classified, but they offer outstanding challenges and opportunities."

sides of Honeywell

BOSTON DIVISION
BOSTON, MASSACHUSETTS

George J. Schwartz, MIT, '42
Vice President
and General Manager

"Our Honeywell division is making the brains of automation. We turn out such small, but complex and important components as gyros, flight controls, servos, synchros, electronic amplifiers and magnetic controls. Engineering projects now in progress point to many new products and applications from our division, including development of new transistor applications. Opportunities? They're here by the score."

MICRO SWITCH DIVISION
FREEPORT, ILLINOIS

R. W. Pashby, BSEE,
U. of Illinois, 1932
Director of Product Research

"Products of our Micro Switch Division help giant aircraft land safely, interlock machine tool operations, feed instructions into electronic computers. These are just a few of their applications—applications which are growing year after year. The development of these precision switches requires high engineering skill, puts a premium on your imagination, offers you tremendous opportunities for advancement and recognition."

RESIDENTIAL, RETAIL AND
COMMERCIAL DIVISION
MINNEAPOLIS, MINNESOTA

H. T. Sparrow, BSEE,
U. of Minnesota, 1930
Director of Product Research

"We specialize almost entirely in comfort control. Typical of the advances our division has made recently is the Supervisory Data Center* which enables one man in one location to read and control the temperature of every room in a large building. Our other new products include Air Blenders, Zone Control Systems, Electronic Air Cleaners and many more. Our business is a rewarding one for engineers!"

INDUSTRIAL INSTRUMENTS DIVISION
PHILADELPHIA, PENNSYLVANIA

C. L. Peterson, BSEE,
U. of California, 1924
Vice President and Gen. Mgr.

"No company in the fast growing instrumentation field is growing faster than Honeywell's Industrial Instruments Division. There's practically no physical quantity under the sun that Honeywell instruments cannot measure, and, in most cases, control, from open hearth furnaces to complex processes still on the designer's boards. Finding new applications and designing the instruments, computers and read-out devices of tomorrow, offer you a fascinating present and an unlimited future."

HEILAND DIVISION
DENVER, COLORADO

S. A. Keller, BS,
U. of Pennsylvania, 1941
General Manager

"This division of Honeywell manufactures two different classes of products: Instruments and Photographic Equipment. Our recording oscillographs—typified by the radically new 'Visicorder'—are used in a wide range of industrial, scientific, and military applications. Our famous 'Strobonar' electronic flash equipment is used by 5 out of 6 newspapers and all important press services. The variety of products and markets of the Heiland Division promises an ever-expanding field that challenges young engineers."

This is Honeywell: more than 12,000 highly engineered products, 14 separate divisions, locations sprinkled throughout this country and abroad, projects by the hundreds on the outposts of every major technological advance. It's a land of opportunity for the engineering graduate. Want to learn more about it? Send for our free booklet, "Your Curve of Opportunity." Write to:

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TECHNIBRIEFS

RECHARGEABLE BATTERY

A tiny dry-cell battery that can be recharged to provide electricity for years has been developed by the Naval Ordnance Laboratory. The battery, nicknamed the "mighty midget," was developed for control units in missiles of underwater mines. The Naval Ordnance Laboratory believes, however, that the battery is readily adaptable for civilian use in powering the miniature electronic circuits of hearing aids, portable radios, walkie-talkie transceivers, and intercommunication systems in the home or the office.

No bigger than a 50-cent piece, the battery has a significant advantage in that, unlike the conventional dry-cell battery, it can be recharged once it has run down. The battery can be recharged any number of times, thus giving a service life that extends for years.

On the basis of tests thus far, the battery is expected to have a useful life of well over ten years and therefore outlast most other equipment in an electronic circuit. Another major advantage over the conventional cell battery is that the "mighty midget," in an uncharged state can be stored on the shelf for a long time. When it is ready for use, the battery can be charged and placed in an electronic circuit.

The battery has electrodes of silver and lead, with an electrolytic solution of potassium hydroxide. As the battery is discharged, the lead turns to lead oxide and the silver oxide turns to silver. This process is reversed with recharging. The battery, which is enclosed in a metal case about the size of a man's wrist watch, delivers nine-tenths of a volt of power as compared with the 1½ volt output of the common dry cell. It has a capacity of 1½ ampere hours of electricity. The battery, however, can be wired in series or parallel circuits to give any desired voltage or amperage.

POWDERS FOR LOW-TEMPERATURE INSULATION

The Cryogenic Engineering Laboratory of the National Bureau of Standards, Boulder (Colo.) Laboratories, has undertaken to improve the Dewar vessel with the aim of developing methods that are adaptable to large-scale equipment. This project is one aspect of a broad program devoted to developing and improving cryogenic techniques and obtaining engineering data.

One of the most important problems in low-temperature technology is that of keeping heat out of low-temperature equipment. The problem of thermal isolation from the external surroundings was largely solved by Sir James Dewar, who contributed one of the most important inventions to cryogenic technique—the vacuum-jacketed container, that has walls of high reflectivity for rejecting thermal radiation.

For large-scale apparatus, investigation has indicated that evacuated powders such as perlite, diamataceous earth, and silica aerogel provide a decided improvement over the standard vacuum-walled, low-emissivity Dewar vessel. In addition, the evacuated-powder insulated vessel can have high-emissivity walls and a thousand times greater gas pressure without destroying its usefulness as an efficient low-temperature vessel.

By using the methods now available, one can make the over-all thermal resistance of a vessel with a 2- to 3-cm thickness of some evacuated powders as good as or better than a "high-vacuum" jacketed vessel in the temperature interval of 300° to 76°K.

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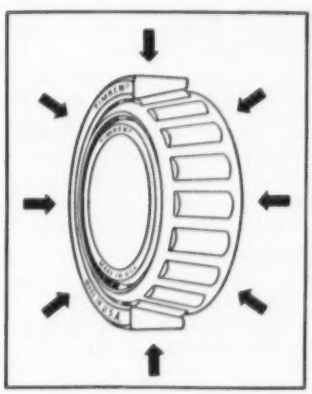
How to lick a mixing problem

IN designing the bearing mounting for the drum axle of this heavy-duty mixer, the engineers had to consider the punishing radial and thrust loads as the drum rotates at an angle. And heavy shock loads from the impact of driving on rough roads had to be considered, too. To handle these loads simultaneously, keep the drum shaft aligned, the engineers specified Timken® tapered roller bearings. Result —free rolling, longer life, less maintenance.



Tapered design lets Timken® bearings take both radial and thrust loads

The taper enables Timken bearings to take radial and thrust loads in any combination. And full line contact between their rollers and races gives Timken bearings extra capacity for the toughest loads.

Want to learn more about bearings or job opportunities?

You'll probably face some bearing problems after graduation. Why not learn about them now with our free 270-page General Information Manual on Timken bearings? And for job information write for "Career Opportunities at the Timken Company". The Timken Roller Bearing Company, Canton 6, Ohio.

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TAPERED ROLLER BEARINGS

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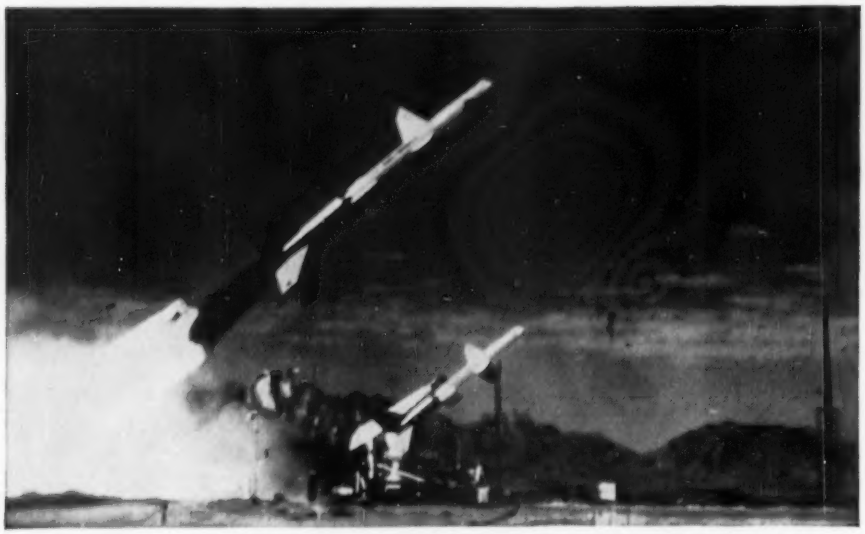
E.E.'s, M.E.'s, A.E.'s, Math, Physics and Chemistry Majors:



First uncensored photo of TALOS, long range guided missile developed by APL for the Navy.

Technical achievement is our sole concern

The Applied Physics Laboratory (APL) of The Johns Hopkins University exists solely to make scientific and technical advances. For this reason we are able to offer our staff members freedom to explore tangential ideas, which frequently lead to significant accomplishments. Among our "firsts" are the world's first supersonic ramjet and the first large booster rocket. As far back as 1948 we achieved fully-guided supersonic flight.

Today two guided missiles that grew out of our pioneer work are in production: the TERRIER is now a fleet service weapon, and TALOS (above) has been adapted for land as well as ship-based operation. When TALOS was recently unveiled by the Navy, APL shared honors with many associate and subcontractors who had worked under our technical direction in its development.

We are presently engaged in missile assignments of a highly advanced nature which cannot be divulged for security reasons. Suffice it to say that, as always, our work is of such vital importance and urgency that little is spared to facilitate its progress. Scientists and engineers at APL are in the vanguard of science and enjoy the keenest sort of responsibility and challenge.

For information on opportunities awaiting men with better-than-average academic records, ask your Placement Officer for our new 30-page publication or write: Professional Staff Appointments.

The Johns Hopkins University Applied Physics Laboratory

8621 Georgia Avenue, Silver Spring, Maryland

First Place Tau Beta Pi Essay . . .

THE PUBLIC SCHOOL SYSTEM

by Jeffrey Gormon, C.E. '58

The public school system of today—in both grammar and high schools—is a product of early America's desire for "education for all". Unfortunately, as the public school system developed "education for all" was expanded to "equal education for all".

This concept of "equal education for all" has led to some bad results. Since the course of instruction in public schools is aimed at all students, or at least all those who are not mentally retarded, it must be designed for a lower than average student, so that he can receive the same education as the brighter student.

The results of this low level of instruction are obvious. First, few students receive a really adequate education—the only students receiving an education commensurate with their ability are those for whom the course is designed, the lower than average students. Secondly, colleges and universities have had to devote an enormous part of their curricula to teaching entering students the basics of math, science, languages, and most important, self-expression. A third result is that the brighter public school students receive little attention in the classroom—the less bright students occupy the majority of the teacher's time. Juvenile delinquency among intelligent children may be due in part to this neglect.

It is apparent that the public school system is not serving America the way it could and should. To better this condition the concept of public education will have to be changed from "equal education for all" to "equal educational opportunity for all"; democracy in education will have to mean that all shall have the opportunity to develop themselves to the maximum, not that all shall have an equal education regardless of ability.

America's public school system must be revised, recognizing that abilities differ, and planning for these differences. Students will have to be classified, perhaps according to I. Q. tests, or better, according to their reading ability. With this classification system in effect, it would then be possible to educate each student at a rate commensurate with his ability.

The effects of this new public school system would be far reaching. The brighter students would, upon graduation from high school, be ready to undertake really advanced college level courses. The average student would have received a real education that really prepared him for college work, not just a token diploma, and the lower than average student would be at least as well prepared for some useful job as he is now.

As the public school system exists now it is wasting the time and abilities of most of America's youth. To correct this we will have to change our philosophy of democratic education and the mechanics of our public school system so as to provide the maximum of educational opportunity to all youth. Once this change occurs the level of education in America will rise, with a corresponding rise in America's productivity and progress.

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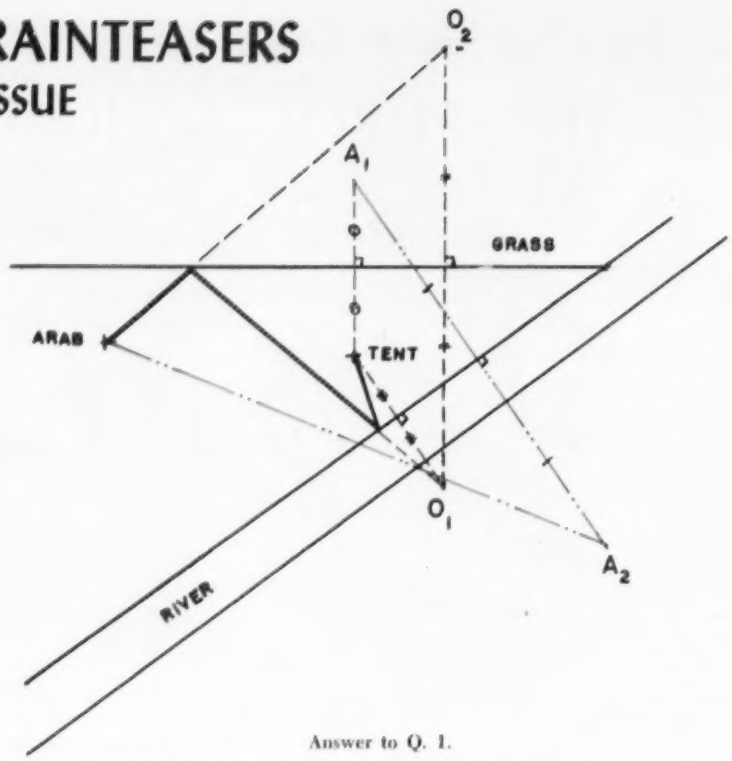
ANSWERS TO BRAINTEASERS
IN MAY ISSUE

1. The shortest distance for the Arab to his tent stopping at the grass for his camel and the river for a drink, is from the reflected image of his tent to his present position in the desert. The location of the image of his tent is obtained by the reflection of the tent in the river, a_1, and the reflection of a_1 in the border of the pasture, a_2. The reflecting path can be reversed by going first from the grass and then to the river to get the points A_1 and A_2 but this is not the shortest distance since a_2 is nearer to the Arab than A_2. The length a_2 to the Arab is the shortest distance to the tent when both the river and the grass are touched. All that remains to do is to find the actual path. This is the bold line on the map, which can be proven by geometry to be equal to the line a_2 to the Arab.



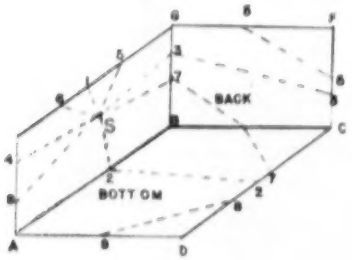
Answer to Q. 1.

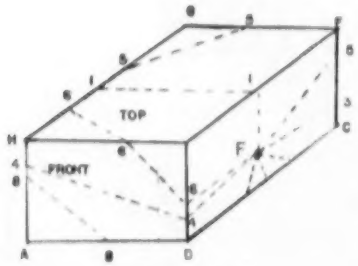
2. Distance = Velocity × Time

$$V = \frac{0.65 \text{ (mile)}}{1 \text{ (hour)}} = \frac{0.65 \times 5280 \times 12}{60 \times 60} = \frac{41{,}184 \text{ (inches)}}{3{,}600 \text{ (seconds)}}$$

$$\text{Distance} = \frac{41{,}184}{3{,}600} \times \frac{625}{11} = 650 \text{ inches.}$$

Let l = length, w = width, h = height





Answer to Q. 2.

The lengths of the various paths may then be expressed:

Paths		*Distance*
1, 2	a)	$l + h = 650$ inches
3, 4	b)	$\sqrt{160^2 + (l+w)^2} = 650$ inches
5, 6, 7, 8	c)	$\sqrt{\left[\left(\frac{h+w}{2}\right) + 80\right]^2 + \left(l + \frac{h+w}{2} - 80\right)^2} = 650$ inches

from these we get

1) $l + h = 650$
$(l+w)^2 = 650^2 - 160^2 = 396900 = 630^2$

2) $l + w = 630$
adding 1+2, we have
$2l + h + w = 1{,}280$ or
$l + \frac{h+w}{2} = 640$

Equation c now gives

$$\left(\frac{h+w}{2} + 80\right)^2 = 650^2 -$$
$$(640-80)^2 = 650^2 - 560^2$$
$$= 108900 = 330^2$$

3) or $h+w = 500$

from 1, 2, and 3 we get
$l = 390$ inches, $w = 240$ inches, $h = 260$ inches

3. Let p, q, r, . . . be the given divisors, and let a, b, c, . . . be the corresponding remainders. The number M = pqr . . . is divisible by every divisor, and each of the numbers P = qr . . ., Q = pr . . ., R = pqs . . ., are divisible by every divisor but one. We must find a convenient multiple g(P) of P which yields the remainder 1 on division by p. Similarly for Q. (etc.).

Then N, the number we are seeking = gPa + hQb . . . . ± any multiple of M. N must be less than the product of all the divisors.

In our case the selected number will be

$N \equiv 70a + 216 + 15c \pm nM$

where P = 35, Q = 21, R = 15
p = 3, q = 5, r = 7
a = 2, b = 2, c = 5

$gP = g35$. g must be some integer multiple so that

$$\frac{gP}{p} = A + 1.$$

in our case g = 2 since

$$\frac{70}{3} = A + 1$$

∴ h of hQb = 1 since

$$\frac{1(21)}{5} = A + 1$$

and

l of lRc = 1 since

$$\frac{1(15)}{7} = A + 1$$

∴ $N \equiv 70(2) + 21(2) + 15(5) \pm nM$ $\quad M = 7(5)3 = 105$

$N = 257 \pm n(105)$

where n = 1, 2, 3, 4 . . . .

but $N < 105$ and $N > 0$

∴ $N = 257 - 2(105)$

$N = 47$ lines Ans. (47)

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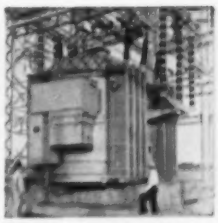
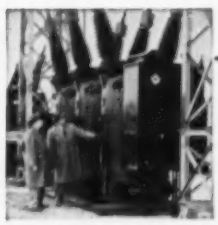
POWER EQUIPMENT

Steam Turbines



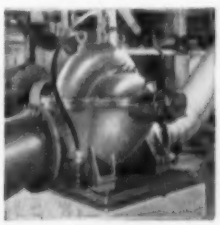
Transformers of all Types



Circuit Breakers

CONSTRUCTION

Road Building Equipment



Pumps, Blowers

Cement-Making Equipment

MANUFACTURING

Motors

Control

V-Belt Drives

Opportunities in these fields

- Thermodynamics
- Acoustics
- System Analysis (Electrical and Mechanical)
- Stress Analysis
- Hydraulics
- Electronics
- Process Engineering
- Mechanical Design
- Structural Design
- Metallurgy
- Nucleonics
- High Voltage Phenomenon
- Analog and Digital Computers
- Fluid Dynamics
- Basic Research

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BOOK REVIEW

by Prof. Byron E. Short

Engineering Thermodynamics by Prof. C. Osborn Mackey, Cornell University. John Wiley & Sons, New York, 1957.

Thermodynamics concerns the transformation of energy from one form to another. In its broadest sense energy transformations in biological areas as well as chemical and nuclear areas could be implied. In engineering we are concerned with the transformation of energy from "natural" sources found in fuels such as coal, gas, and oil which involve reactions at the molecular level and those found in fuels like uranium and plutonium which involve reactions at the atomic level. We want these transformations to occur in such a manner as to permit the resultant energy forms of work, electrical energy, heating and cooling to be utilized gainfully. Ultimate utilization may be to propel automobiles, airplanes, ships and blowers, to produce refrigeration and illumination or to send messages by radio, telegraph and television.

Classic Text Rewritten

The series of books "Heat-Power Engineering" by the late professors Barnard, Ellenwood and Hirshfeld (all at one time teachers at Cornell) of which the book "Engineering Thermodynamics" is considered a rewriting, was a classic as a textbook in its field. However, heat power equipment has changed considerably in the past thirty years. Now the engineer must understand a greater range of types of processes than formerly and if we continue to advance, the student's knowledge of thermodynamics must be more fundamental. Further improvement in the performance of machines or changes in design can be made only by a greater refinement of the analysis which the engineer makes. Steps in thermodynamic analysis which were formerly neglected as being unimportant can no longer be overlooked.

With this in mind it is fitting to contrast the material in "Engineering Thermodynamics" with the content of "Heat-Power Engineering." The overall principles were covered in "Heat-Power Engineering" as in "Engineering Thermodynamics" but in many instances the language and the content used by Prof. Mackey allows for broader concepts. For example, we considered two laws to be "The law of the conservation of matter" and "The law of the conservation of energy." With the increased nuclear activity we recognize that the student should know that energy and mass are transferable, but that we are still at a stage where it is convenient to treat mass and energy quantities as independent items in most analysis. Also we have been able to analyze most machine processes on the thermodynamic side as steady flow or non-flow processes. Now we find that increased speed and very short time duration processes make transient and periodic law phenomena no longer negligible. Professor Mackey has introduced this in his new book.

About the Author

Professor Byron E. Short is professor of mechanical engineering at the University of Texas, in charge of all fluid mechanics and thermodynamic courses. He holds a BSinME (1926) and an MSinME (1930) from the University of Texas. At Cornell University he earned the MME and PhD. He was an engineer for the Texas Company and a consultant for the Gulf Sulphur Company. During this last summer he was a Research Participant at the Oak Ridge National Laboratory where he was involved in heat transfer work with reactor test facilities. He is a Fellow of the ASME and a member of the ASRE, ASEE and AAAS. He has just completed the job of Editor-in-Chief of the 10th Edition of the Design Volume of the ASRE Data Book.

EQUATIONS FOR NEW PLOTS

Formerly we were able to do quite well with analysis based upon ideal gases or with a few charted properties of water vapor and refrigerants. Closer analysis of the processes at higher pressures and/or temperatures require that departures of the substances from the ideal gas law be more accurately treated. We do not usually find charts or tables of properties for a substance which has not been used extensively before. Yet, we need information about its use in a process which can be given only by charted values. The chapter "General Thermodynamic Equations" gives the student basic relations by which limited data on a particular substance may be expanded into a more complete and accurate plot. It also gives the student a better understanding of the relations which exist between chemical properties of a substance and its thermodynamic properties.

We have been satisfied, heretofore, with a separate treatment of flow processes without friction and with friction, allowing for the frictional effects by "efficiency factors." Also higher speed flows which extend into the supersonic region need more complete analysis now than were formerly required in turbine nozzles and blade passages. The chapter which treats steady one-dimensional flow of ideal gases introduces friction for both adibatic and non-adibatic cases. For the student who is likely to be involved in aerodynamic work or with high capacity turbines, compressors or jets, a knowledge of such processes is indispensable.

IDEAL GAS REACTIONS

Combustion in high capacity reciprocating machines, gas turbines, jets and rockets must be more accurately and efficiently controlled

than was true for slow speed machines. Combustion space for such machines must allow for high velocity flows, transient and periodic flows as well as for new fuels which were not used twenty years ago. The chapter on ideal gas reactions outlines the principles which the student needs for such work.

The chapter which treats compression of air and other gases presents the thermodynamics for centrifugal and axial flow compressors as well as for the reciprocating and rotating machines.

Gas turbines, turbo jets and rockets are treated thermodynamically with gas engine cycles, because of the relative importance of these machines at the present time.

CONTENT CONDENSED

With these specific examples of new material in "Engineering Thermodynamics" as contrasted to "Heat-Power Engineering" it is desirable to point to another difference which is a result of the trend in engineering education. The total coverage by "Heat-Power Engineering" required the space of three volumes. Currently it is felt that the student must master the major part of the material which we formerly covered in three volumes in a much shorter period of time scholastically besides learning new material. Professor Mackey has followed this concept and need by combining the material in a single book, omitting many of the less important details which pertain to changing equipment, and still keeping the relatively fixed fundamentals in the foreground. He has retained one principle which many of the thermodynamic teachers like and which many of us claim to be distinctive for true engineering students. That is, he has used machine and plant cycles as the basis for the application of principles. This gives the student something tangible with which to work.

APPLICATIONS MOTIVATE INTEREST

This can be re-stressed in conclusion by quoting from Professor Mackey's preface, "This book has been written for students who have had the usual prerequisites of mathematics, physics, chemistry and mechanics. It is written for the serious student who expects to make a profession of engineering. There appears to be a growing trend to drop from engineering curricula, except at advanced or elective levels, the so-called 'applied' courses, like combustion engines, steam power plants, refrigeration, and air conditioning. Thus it has become mandatory to teach more applied thermodynamics in the courses in engineering thermodynamics. The engineering student is usually pleased with this approach, because he has a great interest in the applications of basic principles. He will learn these principles more thoroughly when motivated by his interest in the applications."

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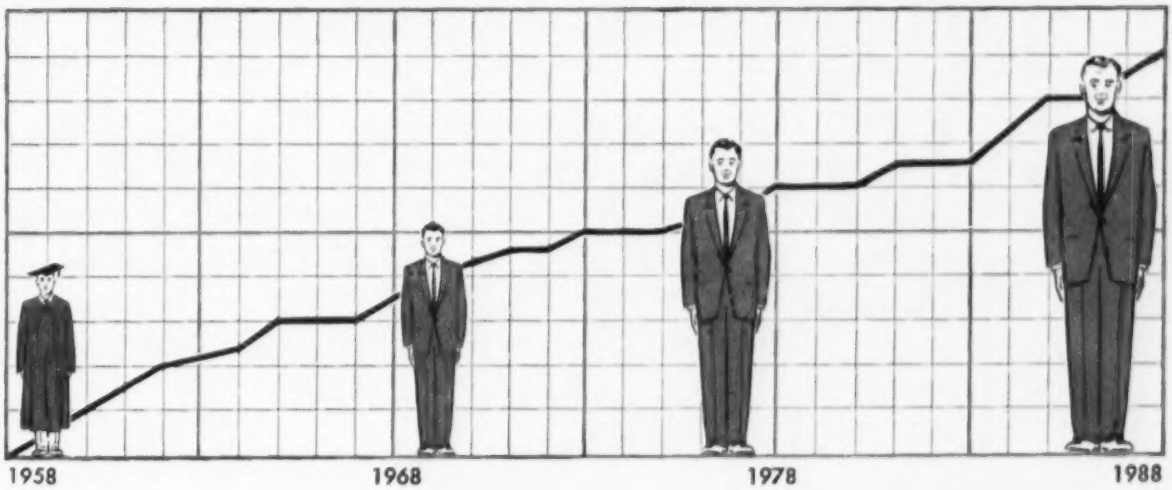

To plan ahead and get ahead...

PICK THE STEADY GROWTH

RIGHT NOW, your business future lies entirely *ahead* of you. On the "curve" of your predictable future, there's no place to go but up. But project that curve ahead 20 or 30 years; you want it to keep right on going up—*steadily*. With this end in view, you are probably looking for a future with what you believe is a "growth company."

This term, however, might be misleading. To evaluate it on a long-term basis, measure this growth against time. Is it *too fast* for stability? Is it *too slow* and uncertain for your personal advancement? Or is it *steady* enough to give you confidence in your own future growth?

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• • •

Customer: "I'd like 15 cents worth of quinine, please."

Druggist: "Here you are, sir."

Customer (a moment later): "Help, I'm poisoned."

Druggist (looking at the box): "You're right, that stuff's strychnine. That'll be 10 cents extra. Pay me quick, that stuff works fast."

• • •

An engineer bought a bottle of bourbon. On his way across the street he was knocked down by a car. Picking himself up he started to walk away, when he felt something warm trickling down his pants leg. "Oh, Lord," he groaned, "I hope that's blood."

• • •

Nine out of ten doctors who tried Camels prefer women.

• • •

"Your husband looks like a brilliant man. I suppose he knows practically everything."

"Don't be silly. He doesn't suspect anything."

• • •

Road Signs:

"Soft Shoulders"
"Danger Curves"
"Men at Work"
"Danger"
"Slow Down"
"Stop"
"Look out for Children"

• • •

Jack and Jill went up the hill
Upon a moonlight ride.
When Jack came back
One eye was black—
His pal, you see, had lied.

• • •

Then there was the fellow who had a hobby of collecting rocks and putting them in his bathroom. He had rocks in his head.

• • •

"This means a good deal to me," said the poker player as he stacked the cards.

• • •

I had twelve bottles of whisky in my cellar, and my wife told me to empty the contents of each and every bottle down the sink, or else! I promised to do so and, without further ado, proceeded with the unpleasant task.

I withdrew the cork from the first bottle and poured the contents down the sink, with the exception of one glass which I drank. I extracted the cork from the second bottle and did likewise, with the exception of one glass which I drank. Then I withdrew the cork from the third bottle, and emptied the good old booze down the sink, with the exception of one bottle which I drank. I pulled the bottle down the glass which I drank. I pulled the bottle from the cork of the next, and drank one sink cork from the fourth sink, and poured the rest down the glass. I pulled the sink out of the next glass and poured the cork down the glass, and drank the bottle. Then I corked the sink with the glass, bottled the drink, and drank the pour.

When I had everything emptied out, I steadied the house with one hand, and counted the bottles, corks and glasses with the other, which were twenty-nine. To be sure I counted again when they came around, and I had seventy-four and as the house came by I counted them all again, and finally I had all the houses and bottles and the corks and the glasses counted, except one house and one bottle, which I drank.

• • •

Funeral director to aged mourner. "How old are you?"

"I'm 97; be 98 next month."

"Hardly worth going home, is it?"

• • •

It was during finals and the usual capacity crowd was at the flicks watching some typical Hollywood love scene where a Romeo was successfully snowing his Juliet down from her balcony. Needless to say, the air was thick with envious comment on his smoothness and savoir-faire. Suddenly from the dim recesses of the theater a masculine voice pleaded, "Hey, quiet, you guys. I'm taking notes."

And a distinctly feminine voice behind us murmured, "Drop by tomorrow, square, and I'll give you the exam."

• • •

The Engineer

They gave me a job to design today,
With a hole and a couple of grooves.
It's only a cleat that goes under the door
To restrain it whenever it moves.
I could sketch it with a couple of lines
And put on a size or two,
But that wouldn't show how much I know
So I'm sure it would never do.
So I'll cut it all up into sections,
With a symbol beside every part,
And I want to be sure to be very obscure,
As to where the machining will start.
Then it's time to put on the dimensions,
And that's when I really unload
For I'll mark all lines with mysterious signs
That Einstein could never decode.
Now my drawing is finished and printed
And I'm proud of the hazy design,
For I know there will be chaos and ulcers
When it finally comes out on the line,
And a feeling of pride starts stirring inside
As my tracing is filed on the shelf,
For my problem is solved with a print so involved
That I can't even read it myself.

• • •

Ruth rode in my new convertible
On the seat in back of me,
I hit a bump at fifty-five
And rode on ruthlessly.

• • •

It was my intention to write a column of jokes. I have written a column. Now read the articles. They're probably funnier.

• • •

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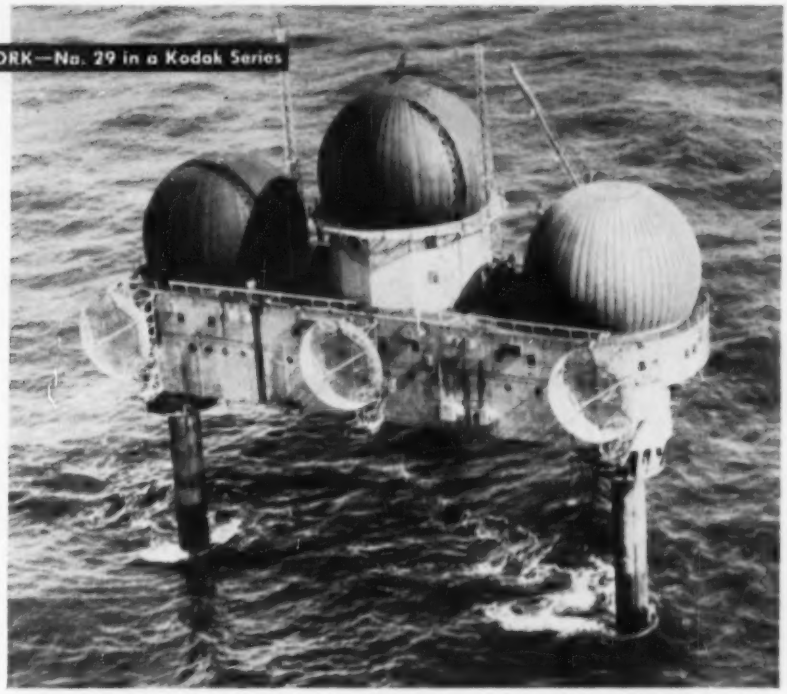

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One of a series

Interview with General Electric's Frank T. Lewis Mgr., Manufacturing Personnel Development

The Next Four Years: Your Most Important

The United States is now doubling its use of electrical energy every eight years. In order to maintain its position as the leading manufacturer in this fast-growing electrical industry, General Electric is vitally interested in the development of young engineers. Here, Mr. Lewis answers some questions concerning your personal development.

Q. Mr. Lewis, do you think, on entering industry, it's best to specialize immediately, or get broad experience first?

A. Let me give you somewhat of a double-barreled answer. We at General Electric think it's best to get broad experience in a specialized field. By that, I mean our training programs allow you to select the special kind of work which meets your interests—manufacturing, engineering, or technical marketing—and then rotate assignments to give you broad experience within that area.

Q. Are training assignments of a predetermined length and type or does the individual have some influence in determining them?

A. Training programs, by virtue of being programs, have outlined assignments but still provide real opportunities for self-development. We try our best to tailor assignments to the individual's desires and demonstrated abilities.

Q. Do you mean, then, that I could just stay on a job if I like it?

A. That's right. Our programs are both to train you and help you find your place. If you find it somewhere along the way, to your satisfaction and ours, fine.

Q. What types of study courses are included in the training programs and when are the courses taken?

A. Each of our programs has graduate-level courses conducted by experienced G-E engineers. These courses supplement your college training and tie it in with required industrial techniques. Some are taken on Company time, some on your own.

Q. What kind of help do you offer employees in getting graduate schooling?

A. G.E.'s two principal programs of graduate study aid are the Honors Program and the Tuition Refund Program. If accepted on the Honors Program you can obtain a master's degree, tuition free, in 18 months while earning up to 75% of full-time salary. The Tuition Refund Program offers you up to 100% refund of tuition and related fees when you complete graduate courses approved by your department manager. These courses are taken outside normal working hours and must be related to your field of work.

Q. What are the benefits of joining a company first, then going into military service if necessary.

A. We work it this way. If you are hired and are only with the Company a week before reporting to military service, you are considered to be performing continuous service while you are away and you will have your job when you return. In determining your starting salary again, due consideration is given experience you've gained and changes in salary structure made in your absence. In addition, you accrue pension and paid-vacation rights.

Q. Do you advise getting a professional engineer's license? What's it worth to me?

A. There are only a few cases where a license is required at G.E., but we certainly encourage all engineers to strive for one. At present, nearly a quarter of our engineers are licensed and the percentage is constantly increasing. What's it worth? A license gives you professional status and the recognition and prestige that go with it. You may find, in years to come, that a license will be required in more and more instances. Now, while your studies are fresh in your mind, is the best time to undertake the requirements.

Your next four years are most important. During that period you'll undoubtedly make your important career decisions, select and complete training programs to supplement your academic training, and pursue graduate schooling, if you choose. These are the years for personal development — for shaping yourself to the needs of the future. If you have questions still unanswered, write to me at Section 959-6, General Electric Co., Schenectady 5, N. Y.

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